PB85-233310

Environmental Protection Agency Evaluation of the AUTOTHERM Energy Conservation System under Section 511 of the Motor Vehicle Information and Cost Savings Act

(U.S.) Environmental Protection Agency
Ann Arbor, MI

Jan 85

U.S. Department of Commerce
National Technical Information Service
NTIS

PB85-233310

EPA-AA-TEB-511-85-1

EPA Evaluation of the AUTOTHERM Energy Conservation System Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

William M. Pidgeon

January 1985

Test and Evaluation Branch
Emission Control Technology Division
Office of Mobile Sources
U.S. Environmental Protection Agency

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA-AA-TEB-511-85-1

2.

3. RECIPIENT'S ACCESSION NO.
PB85 233310/AS

4. TITLE AND SUBTITLE
EPA Evaluation of the AUTOTHERM Energy Conservation System Under Section 511 of the Motor Vehicle Information and Cost Savings Act.

5. REPORT DATE
January 1985

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
William M. Pidgeon

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U.S. EPA
Office of Mobile Sources
Test and Evaluation Branch
Ann Arbor, MI 48105

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS

13. TYPE OF REPORT AND PERIOD COVERED
Technical

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document announces the conclusions of the EPA evaluation of the "AUTOTHERM Energy Conservation System" device under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act.

The evalution of the "AUTOTHERM Energy Conservation System" was conducted upon the application of the manufacturer. The device allows using the vehicle's heater while parked with the engine off. Using the device is claimed to: 1) conserve fuel, 2) eliminate the exhaust pollutants that are generated when vehicle warmth is maintained by idling the engine, and, 3) lower maintenance costs. The device is also claimed to improve safety by eliminating the need to leave an unattended vehicle with its engine idling to maintain warmth. Carbon monoxide poisoning risks are also alleviated. The device consists of a circulator that pumps engine coolant through the vehicle's heater core to utilize the residual heat in the engine, and electrical circuitry to control the operation of the device.

EPA fully considered all of the information submitted by the applicant. The evaluation of the "AUTOTHERM Energy Conservation System" was based on that information and the results of an Air Force test project. Based on engineering judgement, the National Bureau of Standards evalution, and the Air Force data,

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Automobiles Fuel Consumption Exhaust Emissions Tests	Fuel Economy Gas Saving Devices	

18. DISTRIBUTION STATEMENT
Release Unlimited

19. SECURITY CLASS *(This Report)*
Unclassified

20. SECURITY CLASS *(This page)*
Unclassified

21. NO. OF PAGES
85

22. PRICE

EPA Form 2220-1 (9-73)

EPA concludes that, when used, the "AUTOTHERM Energy Conservation System" will conserve fuel and lower exhaust emissions. In most cases, fuel savings should fall between 0.15 and 1.0 gallons of fuel per hour of device use. Engine size and efficiency are the primary determinants of the actual gallons saved per hour of device usage.

EPA Evaluation of the AUTOTHERM Energy Conservation System Under Section 511 of the Motor Vehicle Information and Cost Savings Act

The Motor Vehicle Information and Cost Savings Act requires that EPA evaluate fuel economy retrofit devices and publish a summary of each evaluation in the Federal Register.

EPA evaluations are originated upon the application of any manufacturer of a retrofit device, upon the request of the Federal Trade Commission, or upon the motion of the EPA Administrator. These studies are designed to determine whether the retrofit device increases fuel economy and to determine whether the representations made with respect to the device are accurate. The results of such studies are set forth in a series of reports, of which this is one.

The evaluation of the "AUTOTHERM Energy Conservation System" was conducted upon the application of the manufacturer. The device allows using the vehicle's heater while parked with the engine off. Using the device is claimed to; 1) conserve fuel, 2) eliminate the exhaust pollutants that are generated when vehicle warmth is maintained by idling the engine, and, 3) lower maintenance costs. The device is also claimed to improve safety by eliminating the need to leave an unattended vehicle with its engine idling to maintain warmth. Carbon monoxide poisoning risks are also alleviated. The device consists of a circulator that pumps engine coolant through the vehicle's heater core to utilize the residual heat in the engine, and electrical circuitry to control the operation of the device.

1. Title:

"Application for Evaluation of AUTOTHERM Energy Conservation System Under Section 511 of the Motor Vehicle Information and Cost Savings Act"

The information contained in sections two through five which follow, was supplied by the applicant.

---

2. Identification Information:

a. Marketing Identification of the Product:

AUTOTHERM Energy Conservation System model numbers 2100, 2100T and 2100TT.

b. Inventor and Patent Protection:

(1) Inventor

Frank J. Perhats
314 E. Main Street
Barrington, IL 60010

(2) Patent

No. 4,308,994 (See Attachment A)

c. Applicant:

(1) Frank J. Perhats
Autotherm Sales Corp.
314 E. Main Street
Barrington, IL 60010

(2) Principals

Frank J. Perhats
James V. Enright
Helen L. Tierney

Position titles were not provided

(3) Robert O. Jaeger is authorized to represent Autotherm Sales Corp. in communication with EPA

d. Manufacturer of the Product:

(1) Autotherm Sales Corp.
314 E. Main Street
Barrington, IL 60010

(2) Frank J. Perhats
James V. Enright
Helen L. Tierney

Position titles were not provided

3. Description of Product:

a. Purpose:

"To conserve automotive fuel, save on maintenance costs and eliminate vehicular exhaust gas pollution during the period that many vehicles would be kept idling to provide interior warmth during the winter season. These include law enforcement cars on stationary patrol, traffic control or surveillance, utility service and repair vehicles, public works vehicles, commercial/industrial delivery or service vehicles, over the road trucks, etc., all of which can be seen parked with the engine idling during cold weather. Note: In those cases where the idling vehicle is unattended, the law is being broken in all but four states."

b. Applicability:

(1) Vehicles

"The AUTOTHERM Energy Conservation [System] is applicable to any vehicle with a water cooled engine. Note: We do not as yet have control equipment available for Mercedes Benz vehicles due to their use of vacuum heater controls."

(2) Environmental

"The AUTOTHERM Energy Conservation System is most effective in the colder climates. The enclosed brochure (Form No. TC101) [Attachment B], shows temperature zones on the map of the contiguous United States with some cities having the average number of annual heating days listed. On the reverse side of the brochure additional cities are listed and a chart developed in the controlled environment of the Cadillac Motor Company and Ford Motor Company wind tunnels, indicates heating time of the AUTOTHERM System for various engine sizes and outdoor temperatures."

c. Theory of Operation:

"The AUTOTHERM System uses the heat remaining in the coolant, engine block, etc., when the engine is turned off and circulates the coolant through the vehicle heater and restarts the heater fan. A thermostat turns off the system when coolant temperature reaches approximately 95°F to prevent unnecessary battery drain."

d. Construction and Operation:

"The AUTOTHERM kit consists of:

(1) "A magnetically driven circulator pump which eliminates shaft seals leading to leakage. The pump is guaranteed against leakage for the life of

the original installation. The circulator pump draws approximately 0.5 amps, will circulate over 75% of coolant flow as compared to flow by the engine water pump at idle and has no appreciable restriction to normal heater operation."

(2) A thermostat to turn off the AUTOTHERM System when the coolant temperature reaches 95°F.

(3) A complete wiring harness, relays, master switch and indicator light.

(4) A complete hardware package."

e. Specific Claims for the Product:

"Brochure AMFSB-36-1 [Attachment C] indicates savings of $750.00 to $1500.00 in fuel and maintenance costs per year. These figures are based primarily on law enforcement figures wherein patrol cars average 2-1/2 to 3 hours parked during an eight hour shift, average engine size of 350 CID in moderate to cold zones.

Utility, public works, delivery and service vehicles and taxis often spend an even larger percentage of stationary time. Enclosed is a copy of a fleet fuel survey prepared with the Chicago Police Dept. [Attachment D] using their figures. The savings per car in this case is over $2000.00 annually. A reprint from Law and Order magazine by Deputy Chief Ralph R. Evans also gives savings figures and Report No. 004641 by the Office of Energy Related Inventions of the National Bureau of Standards [Attachment E] supports claims for the AUTOTHERM System on a theoretical basis. The fleet fuel survey portion of forms TC101 [Attachment B] and AM-SB-EV-F-9-001 [Attachment F] make it convenient for each user to determine his or her savings. Use of the AUTOTHERM System eliminates emissions and the effect of excessive idling on engine performance thereby reducing maintenance costs and down time."

f. Cost And Marketing Information:

"Retail price sheet form L-1-005 [Attachment G] is enclosed. The AUTOTHERM System has been marketed for over five years through manufacturer's agents, by direct mail, media advertising and exhibiting at law enforcement, fleet and energy conservation conventions."

4. Product Installation, Operation, Safety and Maintenance:

   a. Installation - Instructions, Equipment, and Skills Required:

      "A thorough, explicit AUTOTHERM installation and owners manual [Attachment H] is enclosed with each AUTOTHERM kit. A copy is enclosed. No special skills or tools are needed for installation."

   b. Operation:

      "A dash or visor stick-on instruction label, form AM-D-6-2M [Attachment I] is included in each AUTOTHERM kit."

   c. Effects on Vehicle Safety:

      "Since the purpose and function of the AUTOTHERM System is to eliminate idling there is no contribution to an unsafe condition. The system could contribute to safety in snow country where a stalled vehicle could be kept warm on a minimum amount of fuel and minimize the risk of CO poisoning."

   d. Maintenance:

      "No routine maintenance is required."

5. Effects on Emissions and Fuel Economy:

   a. Unregulated Emissions:

      "Since the engine is not running where the AUTOTHERM System is being used there are no exhaust emissions."

   b. Regulated Emissions and Fuel Economy:

      "For emissions see 5a, above. Fuel savings will be 100% of amount of expended idling the engine to keep the interior warm."

The following Sections are EPA's analysis and conclusions for the device.

---

6. Testing by EPA:

EPA did not test this device. A detailed report of the testing performed by the Department of the Air Force is given in the Air Force "Project Completion Report No. HP-81-16, Autotherm Heater Car Comfort System (AFR 77-5)," provided as Attachment J. A brief description of this testing effort is given in Section 7e.

7. Analysis

a. Identification Information:

Marketing Identification: EPA knows of no problems with respect to the identification information.

b. Description:

(1) The primary purposes of the device are to eliminate fuel consumption and exhaust emissions during periods when vehicle operators idle their engines to maintain heater operation. The device allows vehicle interior warmth to be maintained without idling the engine. The device is generally marketed for fleet operators such as police departments, utility service and repair vehicles, taxicabs and over the road trucks, etc., which are commonly parked with their engines idling to maintain interior warmth during cold weather.

(2) In determining the applicability of the device, EPA requested additional information (Attachment K) concerning the applicant's claim that the device could not be used with "Mercedes Benz vehicles due to their use of vacuum heater controls." In their letter of August 10, 1984 (Attachment L) the applicant clarified the statement and said that the device can be used in any vehicle except those "whose vacuum controlled air mix door switches to the air conditioning mode on engine shutdown. The 1974 Chrysler was the last American car made with that system. We have not checked Mercedes beyond the 1979 model year since practically none of the fleets using the AUTOTHERM system have Mercedes vehicles."

After receiving this letter, EPA noted a statement in the Fleet Fuel Survey - Form Number AM-SB-EV-F-001 11/81-5M (Attachment F) that said the Model 2100 Energy Conservation System would not work on vehicles with an automatic temperature control heater, but a new model "especially designed for such installation will shortly be available."

In summary, the AUTOTHERM Energy Conservation System is applicable to any water cooled vehicle that does not have: a) a vacuum controlled air mix door that switches to the air conditioning mode on engine shutdown, or b) an automatic temperature control heater.

(3) The theory of operation given in the application was sound but rather brief and did not incorporate the supplementary information that was sent with Autotherm Sales Corporation's application. This additional information included: a) brochure AMFSB-36-1-82-25M (Attachment C), and b) "Fleet Fuel Survey" - Form Number AM-SB-EV-F-001 11/81-5M. (Attachment F)

EPA informed Autotherm Sales Corporation (Attachment K) that EPA would assume that the applicant wished to reference this information "to meet the requirements of Section 3c of the Application Format." Autotherm Sales Corporation's response (Attachment L) did not explicitly state that EPA's assumption was correct, but did imply that they approved it and further suggested that:

> "If you believe it applicable, report 004641, Office of Energy Related Inventions, National Bureau of Standards, might also afford additional information to Section 3c."

This report is provided as Attachment E.

(4) The cost of the device is $172.70 each, in quantities of four or less. Attachment G includes a price list with information on parts prices and quantity discounts. Installation costs were indirectly addressed in one of Autotherm's sales brochures (Attachment C) which claimed; "The system is complete and can be easily installed in less than one hour." EPA judges that most installations will take more than one hour mainly due to the numerous electrical wiring connections. The Air Force experience corroborates EPA's judgment. Their professional mechanics' labor time on four vehicles ranged from 2-1/2 hours to 7 hours with an average of 5-3/4 hours. [Attachment J] Repeated installations, such as on fleets comprised of one vehicle model, should result in more rapid installation times.

c. Installation, Operation, Safety and Maintenance:

(1) Installation - Instructions, Equipment and Skills Required:

EPA's review did not detect any problems with the installation instructions (Attachment H), but EPA did not put the instructions to the test by installing a device. However, the installation instructions seemed to provide good explanations of the procedures and included pictorials and a schematic. The Air Force commented that the "installation instructions appear to be adequate and easily read by the mechanics." (Attachment J)

The applicant stated in Section 4a that no special skills were required for installation, but the installation manual gives the following advice:

> "A V.O.M. (volt-ohm-milliamp meter) will be very useful in locating key points in the vehicle electrical circuit as well as in trouble shooting." (Attachment H)

This statement implies that electrical wiring experience would be helpful. EPA's judgment, based on its review of the installation manual, is that the installer should have some experience with automotive wiring before attempting this installation.

The circulator inlet and outlet fittings are stepped to facilitate installation in heater hose diameters of 1/2", 5/8", or 3/4". The 1/2" diameter circulator fittings will probably restrict coolant flow in 5/8" and 3/4" diameter hoses. The circulator impeller will also restrict the flow in any of these hose sizes, so a minor loss in vehicle heater performance should be expected in most installations.

EPA expects the operating instructions label (Attachment I) to be easily followed.

(2) Effects on Vehicle Safety:

The applicant's comments on safety in Section 4c are reasonable and substantiated by the following Air Force comment:

> "The safety aspects of using the Autotherm unit in lieu of engine idling for periods of time will surely deter possible carbon monoxide poisoning. The best safety aspect is maintaining a warm vehicle while not leaving a vehicle engine idling and vehicle unattended. Although this is against AF policy, it still happens on inclement days." (Attachment J)

(3) Maintenance:

EPA agrees with the applicant's claim that no maintenance is needed.

d. Effects on Emissions and Fuel Economy:

(1) Emissions:

The applicant did not submit test data in accordance with the Federal Test Procedure and the Highway Fuel Economy Test. These two test procedures are the primary ones recognized by EPA for evaluation of fuel economy and emissions for light-duty vehicles.* Although the applicant did not submit test data, EPA agrees with the applicant's following statement in their application regarding regulated and unregulated emissions: "Since the engine is not running where the AUTOTHERM System is being used there are no emissions." However, there are other considerations.

A vehicle may emit more emissions upon starting after using the AUTOTHERM System than if the system had not been used. Using the device cools the engine faster than not using it, and it is generally accepted that hydrocarbon (HC) and carbon monoxide (CO) emissions tend to increase as engine temperature decreases from its normal operating temperature. Therefore, engine startup after use of the device is expected to result in higher HC and CO emissions until normal operating temperature is reached. But if the device is used to eliminate engine idling, the increased emissions upon startup is expected to be insignificant compared to the idle emissions that would otherwise occur. Considering these points, EPA's judgment is that the Autotherm system will not adversely affect regulated or unregulated emissions. EPA did not require testing to verify this judgment.

---

* The requirement for test data following these procedures is stated in the policy documents that EPA sends to each potential applicant. EPA requires duplicate test sequences before and after installation of the device on a minimum of two vehicles. A test sequence consists of a cold start FTP plus a HFET or, as a simplified alternative, a hot start LA-4 plus a HFET. Other data which have been collected in accordance with other standardized procedures are acceptable as supplemental data in EPA's preliminary evaluation of a device.

(2) Fuel Economy:

EPA normally predicts fuel savings for devices on a miles per gallon basis. The Autotherm System is not used while the vehicle is being driven so miles per gallon is not an appropriate measure to predict fuel savings. Instead, EPA has chosen to predict fuel savings in gallons per year for two scenarios. The first scenario is for a small car owner who would use the device three times a week for a half hour each time through the winter months. The second scenario is for a police department with a large light-duty vehicle that is used seven days a week, 24 hours a day, with two hours of device use per eight hour shift. Because there are many variables that determine the actual fuel savings, these scenarios were designed to give the upper and lower limits for applications that might be considered reasonable applications for the device. The assumptions for each case are:

	Minimal Usage	Maximal Usage
Heating Season (weeks)	12	24
Device Usage (hours/week)	1.5	42
Engine Displacement (in.^{3}/L)	85/1.4	400/6.6
Idle Fuel Consumption (gal/hr)	0.15	1.0
Fuel Savings (gal/year)*	2.7	1,008

The results indicate that owners of small vehicles with short winters who infrequently use the device might only save three gallons of fuel per year, whereas a police department with large vehicles, long winters and frequent device usage could save a thousand gallons of fuel per year on one car.

e. Test Results Obtained by EPA:

The device was independently evaluated by the National Bureau of Standards and the Air Force prior to the applicant's request for an EPA evaluation. EPA deemed that the information and data from these reports combined with engineering judgment would enable EPA to derive conclusions without additional testing. EPA therefore did not test the device.

---

*Fuel Savings $\left(\frac{\text{Gallons}}{\text{Year}}\right)=\frac{\text{Weeks Use}}{\text{Year}} \text{ X } \frac{\text{Hours Use}}{\text{Week}} \text{ X } \frac{\text{Idle Fuel Gals}}{\text{Hour}}$

The Bureau of Standards did a theoretical analysis, but did not test the device. Their report concluded: "Autotherm is technically sound in concept and design, and should perform basically as claimed." (Attachment E)

The Air Force reported the following results:

"Comfortable vehicle interior warmth was maintained as follows:

Time in Minutes	Outside Ambient
40	12°F Snowing/no wind
35	12°F Snowing/no wind
31	28°F Slight wind
45	38°F No appreciable wind

Potential safety hazards related to carbon monoxide poisoning and vehicle runaway are considerably reduced when employing Autotherm units. Gallons of gasoline saved varied from 0.76 gallons/hour to 2.3 gallons/hour* for six cylinder vehicles. Cost analysis provided showed bases with a winter season of mean temperatures below 40°F, employing car comfort systems in 10 vehicles will realize savings of approximately

---

* EPA assumed that idle fuel consumption would range between 0.15 gallons per hour and 1.0 gallons per hour in its calculations for potential fuel savings. This 1.0 maximum is significantly less than the 2.3 gallon per hour maximum that the Air Force found. They listed idle fuel consumption data for five six cylinder vehicles that ranged from 0.7 to 0.9 gallons per hour. The cubic inch displacements (CIDs) were not given, but they probably ranged from 225 to 300 CID, based on EPA's knowledge of these vehicles. Their report does not discuss which vehicle was found to consume 2.3 gallons per hour at idle, but this consumption rate is considerably higher than EPA would expect to see on a light-duty vehicle. EPA regulations define a light-duty vehicle to mean a passenger car or passenger car derivative capable of seating twelve passengers or less. The engines in the five known vehicles are old designs that are no longer being sold in light-duty vehicles, so the fuel consumption range of 0.7 to 0.9 is reasonable for older less efficient designs. EPA data on two 1977 vehicles include 0.90 gallons per hour for a 460 CID engine and 0.99 gallons per hour on a 400 CID engine. EPA's judgment is that 0.15 to 1.0 gallons per hour is representative of the range in idle fuel consumption for most light-duty vehicles manufactured between 1975 and 1985.

$2600 and 2000 gallons of gasoline over the winter season.** Tangible savings of over $1000 per vehicle equipped with Autotherm units during 5 year life expectance is probable. AF wide savings for 100 bases with 10 vehicles/base equipped with these units would approximate $1,000,000 over a 5 year period." (Attachment J)

The time that vehicle warmth is maintained is dependent on weather conditions, vehicle interior volume, and the vehicle's engine size. The Air Force data indicated that 2.3 litre - 4 cylinder engine maintained vehicle warmth for 35 minutes whereas a 225 cubic inch (3.7 litre) engine maintained vehicle warmth for 40 minutes under the same weather conditions. A truck or police vehicle with a 400 cubic inch engine could be expected to maintain warmth for significantly longer periods of time, all else being equal. The Air Force results clearly show that the device will maintain comfortable vehicle temperatures for significant durations with the engine turned off. Therefore, if used, the device will fulfill the applicant's claims for improved fuel economy, vehicle comfort, and safety, while decreasing maintenance costs and exhaust emissions.

The degree to which these advantages are realized will vary with the amount of time that drivers will forego idling and use the device. EPA asked the applicant if they had any information on the utilization rates for the device (Attachment K). Their response was as follows:

> "We have no quantitative data on percentage use of the Autotherm system and we have had fleet administrators -- primarily law enforcement -- decline to purchase AUTOTHERM kits based on the fact that they did not believe all of their drivers would use them. Those who purchased the AUTOTHERM system usually ran a test and determined that they could control usage and a savings would result before ordering large quantities. A number of fleet operators have told us the AUTOTHERM system was so well received, they would probably have the system installed for the comfort and morale of their drivers even without a savings. We would not expect 100% usage, but habits can be broken since it is certainly more comfortable to sit in a parked vehicle without the noise, vibration and possible exhaust

---

** The Air Force estimates assume 200 hours of device use per year for each vehicle. This would amount to 1.7 hours per day for 120 days (4 months), which is significantly less than EPA's assumed maximum usage. The Air Force also assumed 0.76 gallons per hour at idle, whereas EPA assumed a maximum idle fuel consumption of 1.0 gallons per hour.

> blowback of an idling engine. Another point regarding those who leave the engine idling while they are not in the vehicle is that they are breaking the law in all but four states by leaving the vehicle unattended with the engine running." (Attachment L)

One possible disadvantage of using the device is the potential for draining the vehicle's battery and the attendant risk of insufficient energy for starting. The Air Force report included data on the device's current draw on two vehicles. It ranged from 2 amps to 11 amps, but the highest draw with the heater fan on low speed was 4 amps. The applicant's operating instructions (Attachment I) specifically say "DO NOT operate fan on high or medium high speeds while using AUTOTHERM." The Air Force did not report any problems with insufficient battery capacity and EPA's judgment is that it will not cause a problem on vehicles with properly maintained batteries and charging systems.

Comments from vehicle operators in the Bureau of Standards report and the Air Force report support the applicant's statements. The author of the National Bureau of Standards report said:

> "I also discussed the invention with two members of the Michigan State Highway Patrol and examined the installation of their vehicle during a trip to Detroit on February 26, 1980; their reaction to the device was favorable and confirmed the performance claims of approximately 1 hour's heat..." (Attachment E)

This vehicle had a large displacement V-8 engine.

The Air Force report included the following:

> "The users were contacted for their comments on the use of installed Autotherm unit. In all cases the operators were very impressed with the comfort provided by the unit without engine running. The taxi driver on the day shift was very impressed with the unit since he would sometimes park awaiting dispatch. With the unit operating during these times his vehicle was always comfortably warm. The same comments were noted by Security Police operators during the day-time and also night operations." (Attachment J).

Because there are no significant disadvantages associated with using the device on vehicles with properly maintained batteries and charging systems, EPA's judgment is that the advantages of using the system will motivate vehicle operators to use the device.

8. Conclusions

EPA fully considered all of the information submitted by the applicant. The evaluation of the AUTOTHERM Energy Conservation System was based on that information and the results of an Air Force test project. Based on engineering judgment, the National Bureau of Standards evaluation, and the Air Force data, EPA concludes that, when used, the Autotherm Energy Conservation System will conserve fuel and lower exhaust emissions. In most cases, fuel savings should fall between 0.15 and 1.0 gallons of fuel per hour of device use. Engine size and efficiency are the primary determinants of the actual gallons saved per hour of device usage.

FOR FURTHER INFORMATION CONTACT: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Sources, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, MI 48105, (313) 668-4299.

List of Attachments

Attachment A	Patent Application (provided with 511 Application)
Attachment B	"Fleet Fuel Survey," Form Number TC-101-9/83.
Attachment C	Brochure AMFSB-36-1/82-25M, a sales brochure without a title.
Attachment D	"Engine Idle - Fuel Consumption Analysis," Example Study - Chicago Police Department.
Attachment E	"Final Technical Review - Autotherm Car Comfort System," OERI No. 004641, Office of Energy Related Inventions, National Bureau of Standards.
Attachment F	"Fleet Fuel Survey," Form No. AM-SB-EV-F-9-001 11/81-5M.
Attachment G	Price List and Warranty, Form No. L-1-005-9/83.
Attachment H	"Installation and Owner's Manual," P/N 01078 11/82.
Attachment I	"Operating Instructions Label," Form No. AM-D-6-2-4/83
Attachment J	Recommendations Resulting from MEEP Project Number H81-16C, Autotherm Heater, Car Comfort System (AFR 77-5), September 22, 1982. Attached to these recommendations is Project Completion Report No. HP 81-16 on the Autotherm Heater.
Attachment K	Letter of July 26, 1984 from EPA to Robert Jaeger of AUTOTHERM Sales Corporation requesting clarification of information in the application and additional information.
Attachment L	Letter of August 10, 1984 from Robert O. Jaeger of Autotherm Sales Corporation to EPA responding to EPA request.

ATTACHMENT A

No 4308994

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Whereas, THERE HAS BEEN PRESENTED TO THE

Commissioner of Patents and Trademarks

A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL INVENTION THE TITLE AND DESCRIPTION OF WHICH ARE CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PATENT AND TRADEMARK OFFICE IN THE CLAIMANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID CLAIMANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A PATENT UNDER THE LAW.

NOW, THEREFORE, THESE Letters Patent ARE TO GRANT UNTO THE SAID CLAIMANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID CLAIMANT(S) FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF ISSUE FEES AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE THERS FROM MAKING, USING OR SELLING THE SAID INVENTION THROUGHOUT THE ITED STATES.

In testimony whereof *I have hereunto set my hand and caused the seal of the* **Patent and Trademark Office** *to be affixed at the City of Washington this fifth day of January in the year of our Lord one thousand nine hundred and eighty-two, and of the Independence of the United States of America the two hundred and sixth.*

Attest:
Ruth C. Mason
Attesting Officer.

United States Patent [19]

Perhats

[11] 4,308,994

[45] Jan. 5, 1982

[54] ENERGY SAVING CIRCULATING SYSTEM FOR VEHICLE HEATERS-

[75] Inventor: Francis J. Perhats, Barrington, Ill.

[73] Assignee: Autotherm, Inc., Barrington, Ill.

[21] Appl. No.: 59,945

[22] Filed: Jul. 23, 1979

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 911,661, Jun. 1, 1978, abandoned.

[51] Int. Cl.³ B60H 1/02
[52] U.S. Cl. .... 237/12.3 B; 318/341; 307/315; 417/420; 417/423 R
[58] Field of Search .... 237/12.3 B, 12.3 R; 417/420, 423; 307/315; 123/142.5 E; 318/341

[56] **References Cited**

U.S. PATENT DOCUMENTS

Re. 26,094	10/1966	Zimmermann	417/420
1,931,145	10/1933	Hall	237/8 R
2,170,032	8/1939	Page	237/12.3 B
2,230,051	1/1941	Conklin	237/12.3 B
2,481,172	9/1949	Staggs	417/420
2,534,520	12/1950	Katcher	417/420
2,612,885	10/1952	Cox	123/142.5 E
2,654,826	10/1953	Spurlin	237/12.3 B
2,749,048	6/1956	Edge	237/12.3 B
2,749,049	6/1956	Smith	237/12.3 B
2,801,802	8/1957	Jackson	237/12.3 B
2,941,477	6/1960	Dalton	417/420
3,074,349	1/1963	Zimmermann	417/423
3,269,653	8/1966	Howard	237/12.3 B
3,306,221	2/1967	Goodpasture	417/420
3,626,148	12/1971	Woytowich	123/142.5 E

OTHER PUBLICATIONS

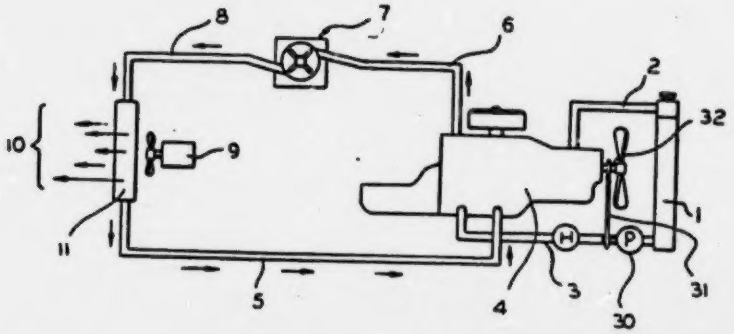
Electronic Design 7, "Switch your High Power Supply Design", Apr. 1, 1975, pp. 116–122.
Solid State Design "of the Darlington Pair", Jun. 1962.

Primary Examiner—Henry C. Yuen
Assistant Examiner—Henry Bennett
Attorney, Agent, or Firm—Alter and Weiss

[57] **ABSTRACT**

An improved low power drain circulating system for vehicle heaters utilizing a magnetic motor power assembly for selectively circulating hot water from the vehicle's engine to the vehicle's heater, even when the engine is shut off, and having self-contained control circuitry to further the economical power consumption of the system.

2 Claims, 5 Drawing Figures



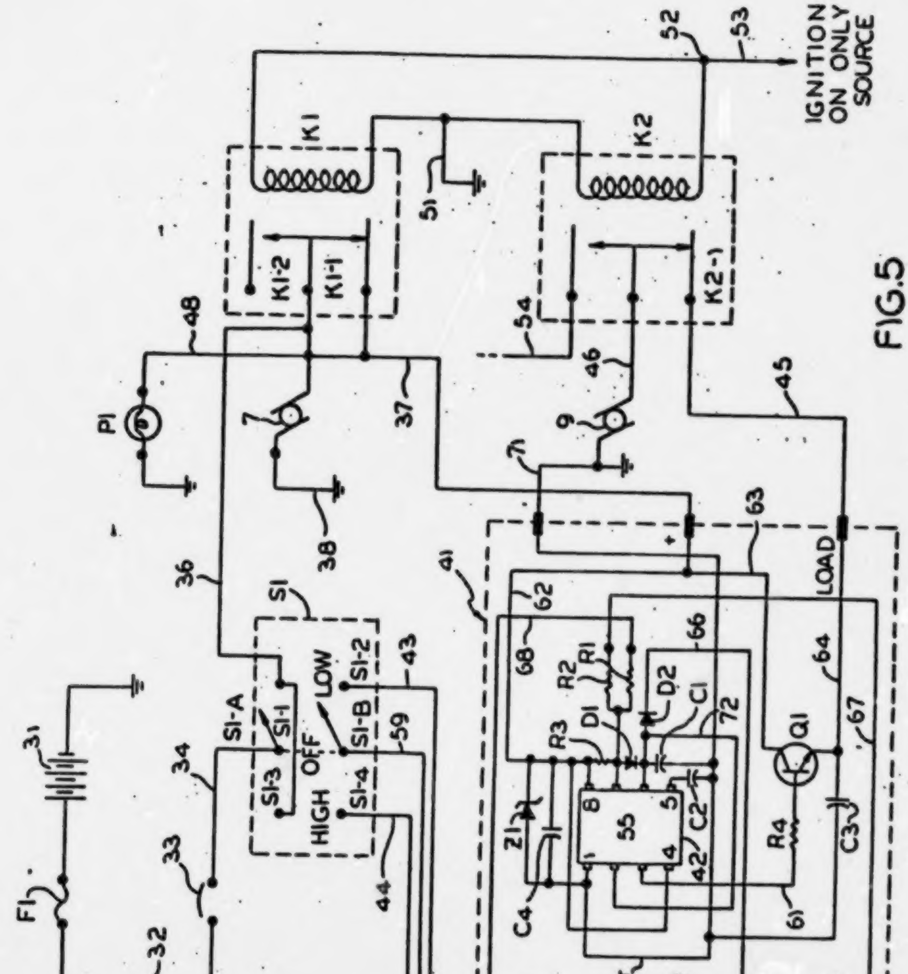

52
53
IGNITION ON ONLY SOURCE
K1
K2
51
K1-2
K1-1
K2-1
54
48
P1
7
37
46
9
45
71
38
36
S1
41
+
63
LOAD
62
68
66
R1
R2
D2
C1
64
Q1
S1-A
S1-1
LOW
S1-2
43
S1-3
OFF
S1-B
59
HIGH
S1-4
34
31
33
F1
32
44
R3
D1
Z1
8
5
55
1
4
C2
72
42
R4
C3
67
61
C4
69
1
2
3
59

FIG.5

ENERGY SAVING CIRCULATING SYSTEM FOR VEHICLE HEATERS

This is a continuation-in-part of my previous application Ser. No. 911,611 now abandoned, filed on June 1, 1978, titled ENERGY SAVING CIRCULATING SYSTEM FOR VEHICLE HEATERS.

This invention relates generally to vehicular and automotive heaters; and more particularly, to improved energy saving auxiliary fluid circulating systems which can be selectively used when the vehicle's engine is turned off.

In the area of vehicular heating systems, it is beneficial to selectively circulate the engine's "cooling" fluid, even while the vehicle's engine is not running. For example, the user of the vehicle then utilizes the vehicle's heater, while the vehicle's engine itself is shut off by circulating heated fluid through its heater. Many benefits accrue to the user of such a system who does not have to run the vehicle's engine to obtain heat from the vehicle's heater in cooler weather

With conventional automotive heater systems, for example, the user must keep the engine idling to keep the vehicle's heater functional, whether he is driving or not. Thus, vehicles which are parked, for example, must waste precious energy, pollute the atmosphere and actually foul present day sensitively tuned engines simply to obtain heat from the vehicle's heater.

The ability to circulate, independently of the vehicle's engine, the already heated fluid within the vehicle's circulating apparatus or fluids heated by devices, such as immersion heaters, enables extended use of the vehicle's heater to transfer warm air into the vehicle's passenger compartments. The need for vehicular heater systems that can warm the passengers, even when the vehicle engine is turned off, has long been recognized; and accordingly, systems have been designed to fill that need.

Systems utilized to continue the circulation of the vehicle heater system's hot water, even when the engine is shut off, have been disclosed in such patents as those of Page, U.S. Pat. No. 2,170,032, and of Conklin, U.S. Pat. No. 2,230,051.

The system disclosed by the Page patent basically utilizes an independent pump and motor incorporated into the vehicle's hot water circuitry. The Page system, because of its reliance upon additional hot water circuitry, requires the utilization of valve means so as to restrict flow to the original vehicle's hot water circuit, when the engine is temporarily shut off and the battery activated independent motor is used.

The Conklin system discloses a simplified version of the Page apparatus which requires no additional hot water circuitry, but rather uses an electric motor driven pump which fits directly into the already existing automotive hot water circuit. As opposed to the Page system, in which a separate spur circuit has to be used, Conklin's use of a pump with a specific construction allows the passage of the engine generated hot water through the pump itself, when its electric motor is not activated and the engine is still running.

Alternatively, in the Conklin system, when the engine is temporarily shut off and hot water is available in the vehicle's cooling system, the electric motor driven pump can be activated to provide auxiliary pumping means through which the hot water is circulated through the heater's hot water core. In this manner, heated air is supplied to the vehicle, while the engine is shut off. Thus, the already existing automobile's hot water system is utilized directly without provision of an auxiliary valve control circuit system.

Improvements to the systems shown in U.S. Pat. Nos. 2,230,051 and 2,170,032 have been made in such patents as that of Jackson, U.S. Pat. No. 3,801,802, which teaches the use of integrated motor pump assemblies which are directly inserted into a vehicle's hot water circuit. Additionally, automatic on/off switching devices and thermostatic controls have been devised to improve the operation and effectiveness of the type of auxiliary heating system as set forth, for example, in U.S. Pat. No. 2,230,051.

There are basic problems inherent in the presently available auxiliary hot water systems for providing hot water circulation through the automobile heater, even while the engine is not being operated. The hot water system of most present day vehicles is pressurized. The high pressures accentuate the necessity of preventing leakage, especially around the shaft of the auxiliary pump used in the auxiliary circulating systems.

Solving the leakage problems by increasing the packing around the shaft merely accentuates another extremely pertinent problem by increasing the friction; and consequently, increasing the system's power drainage. The system, to be effective, must be miserly in its usage of the limited power available.

This invention relates to the novel combination of parts and controls which minimize power usage and nonetheless, provide an extremely reliable long lived circulating system for vehicle heaters.

A magnetically coupled "flow through" centrifugal pump assembly is provided in a system capable of circulating hot water through a vehicle's heater, when the engine of the vehicle is shut off. The combination of the heater circuit and a magnetically driven centrifugal pump assembly preferably utilizes the type of pump assembly described in Zimmerman, U.S. Pat. Nos. 3,074,349, 3,117,526 and RE 26,094.

The use of a magnetically driven centrifugal pump assembly in a vehicle's hot water circuit, which enables use of the heater, when the vehicle's motor is off, yields significant advantages to the user. The lack of bearings in the motor pump assembly, as well as seals, improves the longevity of the motor pump device and decreases the power required by the pump assembly, while securing ease in installation and repair of the system. The magnetically driven pump is particularly effective in the auxiliary circulating system, because of the intense heat and corrosiveness of the circulated water. The circulated water contains inherent rust particles and water additive chemicals which have an extremely detrimental effect on conventional motor pump assemblies causing failure in these assemblies. More particularly, the special additives and foreign particles circulating within the hot water system decompose and interfere with bearing assemblies and seals on conventionally driven centrifugal pump assemblies.

A magnetically driven centrifugal pump assembly is relatively impervious to foreign matter and additives, since no motor shaft orifice is needed in such a pump assembly, so that the contaminated water and chemicals flow through a totally enclosed portion of the pump and are precluded from ever entering into or interfering with the mechanical portion of the pump shaft. Thus, leakage problems at the pump shaft are eliminated.

In the magnetically driven pump used, for example, the only parts with which the contaminated water comes into contact are formed of appropriately chosen thermoplastic resins, such as nylon; thus, minimizing the corrosive and interfering aspects of the contaminated water. It has been found that even though the impeller magnets are not in the main flow path, there is no adverse build up of ferrous particles at the impeller magnets.

Should clogging ever occur due to the flotation of larger sized particles and accumulated smaller particles within the heater circuitry, such a magnetically driven centrifugal pump assembly requires only that the magnetically driven impeller blade itself be removed for cleaning. Additionally, less electrical power is expanded, when the magnetically driven centrifugal pump is used, since less usable energy is lost through friction of seals, bearings, and the like. Further, because of the compactness of the magnetically driven pump assembly, the installation is more easily accomplished, less space is required and the system is thus more attractive to the after-market purchaser.

Utilization of a centrifugal pump in such a system enables flow of water to a vehicle's heater, when the engine is running and pumping the water, while the centrifugal pump is de-energized, since the physical characteristics of a centrifugal pump enable the flow of water therethrough in the same direction as originally driven by the main water pump.

Similarly, the use of the present invention with an immersion heater, which can heat the circulated fluids of a vehicle separately and independently of the vehicle's engine enables more effective utilization of the immersion heater for maintaining engines at temperatures that will facilitate starting the engine, even at extremely low temperatures.

A problem common to all auxiliary vehicular heating systems used primarily while the engine is not running is that of power drainage. The battery life is limited. Therefore, to provide a workable and practical commercial system, it is necessary to minimize power loss. The power loss occurs in running the motor driven pump and in the auxiliary vehicular heating system control circuitry. Thus, both have to be power efficient.

Another problem faced by auxiliary vehicular heating systems is that as the original equipment automatic temperature control systems become more complicated, it becomes more difficult to incorporate auxiliary vehicular heating systems without adversely affecting the operation of the original equipment.

Accordingly, it is an object of the present invention to provide new and unique auxiliary vehicular heating systems which are readily installed without upsetting preexisting systems, use a minimum amount of power, and nonetheless are long lived and reliable.

It is a related object of the present invention to provide an integrated motor pump assembly for installation into a vehicle's original hot water circulating system to enable utilization of the vehicle's heater, when the vehicle's engine is turned off. Even more prolonged and continuous usage of the heater can be made possible through utilization of the invention with a remotely operable immersion heater which serves to heat a vehicle's circulated fluids apart from the fluid heating characteristics of an operating engine.

It is a further object of the present invention to reduce the dependence on bearings and seals within such a motor pump assembly, so as to prevent decomposition and interference to the motor pump assembly from hot and corrosive water and additives circulating through the vehicle's hot water system, as well as to minimize friction and to eliminate the possibilities of water leakage through a motor shaft pump blade connective orifice.

Additionally, it is an object of the present invention to: (1) eliminate the need for entrance of the motor shaft into the actual housing of the pump through which the hot water of the vehicle passes; (2) keep the impeller magnets out of the main flow path of the pumped fluid; and (3) utilize non-metallic parts within that portion of the pump through which the pressurized hot water and corrosive additives pass.

It is a further object of the present invention to provide a compact, easy-to-install motor pump assembly in the vehicle's existing hot water circulating system which is easy to unclog and repair, is not subject to corrosion, rusting or leaking and one which requires significantly less electrical power drain through a more efficient power transmission device.

Yet another object of the present invention is to provide auxiliary vehicular heating systems which have controls that are virtually independent of the originally supplied control circuitry and further reduce the power drain of the original circuitry.

The novel combination of a heater circulating system usable when the engine of a vehicle is off, together with a magnetically driven centrifugal pump assembly and unique pump and fan control circuitry enables these advantages and extend use of the auxiliary heating system; in contrast to prior art systems that are prone to leakage and excessively drain the batteries.

The present invention is a vehicular hot water circulating system for circulating the hot water in a water cooled vehicle so as to enable use of the vehicle's heater, when the vehicle's engine is temporarily shut off. An independently driven circulating pump is positioned in the vehicle's engine block to and through said vehicle's hot water heater, returning back to the vehicle's engine block. The system comprises a magnetically coupled centrifugal pump assembly integrated with an electric motor, such that the circulating pump passively allows passage of hot water to the vehicle's heater, when the hot water is driven through the hot water heating circuit by the vehicle's engine. It is additionally capable, through activation of its electric motor, of continuing the circulation of the vehicle's still hot water, when the vehicle's engine is shut off; thus, enabling effective use of the vehicle's heater.

The magnetically coupled motor pump assembly is installed into the vehicle's existing hot water heater circuitry most easily by simply severing the present circulating conduit, attaching one end of the severed conduit into the input line of the circulating pump and similarly placing the other line of the severed conduit into the output line of the circulating pump. A control box comprising solid state circuitry is used for controlling the operation of the auxiliary pump for the hot water circulating system and vehicle heater fan. The controls of the control box enhance the auxiliary pump system and electrically isolate the auxiliary system. Electrically, the control box is attached to the ignition coil primary, for example, and also to the heater fan, and to the prior power connection of the fan.

When the vehicle's engine is shut off, the motor pump device which has been placed into the hot water circuitry of the vehicle can be activated through the control box manually or by thermostatic controls. The activation of the motor pump unit continues circulation of the still hot water through the vehicle's heater so as to allow the user of such a vehicle a functioning heater, which otherwise would normally be ineffective shortly after the vehicle's engine is shut off.

Additional coupling of the invention with an immersion heater device in one embodiment can prolong the heater's usage even more, so as to avoid premature cooling of the radiator fluids, after the engine is shut off and to aid in starting the engine under extremely cold conditions.

The use of a magnetically coupled centrifugal pump eliminates friction and leakage problems encountered by conventional motor pump assemblies in which the shaft from the motor is coupled directly to the pump impeller blade. Such a conventional motor pump assembly requires the use of seals and bearings and necessary washers to insulate the motor shaft, motor housing the motor circuitry from the fluids circulating through the pump housing, because of their obvious destructive characteristics. In the present invention, however, no shaft is needed to connect the motor to the pump blade within the pump housing; thus, no bearings, seals, washers, etc. are necessary, thereby prolonging the life of the motor pump unit.

Additionally, the motor pump specifications of the present invention is of such a compactness to take up a minimum of space in the vehicle, when installed, so as to facilitate installation, and is of such a fabrication to enable facilitated repair if clogging were to occur from rust particles, and the like in the pump portion of the hot water circulating device. The control incorporated into the auxiliary vehicular heating has no adverse effect on manufacturer installed temperature control systems and aids in reducing power consumption. These qualities further establish the present system as a desirable product for addition to a vehicle in the automotive "after market".

The above mentioned and other objects and features of the present invention together with the manner of obtaining them will be best understood by making reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of the auxiliary hot water circulating system circuitry of the present invention as used in a water cooled vehicle;

FIG. 2 is a side perspective view of the electric motor pump assembly having a magnetically driven centrifugal pump portion;

FIG. 3 is an elevational, cross-sectional view of the magnetically driven centrifugal pump portion of the motor pump assembly taken along lines 3—3 of FIG. 2 and looking in the direction of the arrows;

FIG. 4 is a top view of the pump blade used within the magnetically driven centrifugal pump portion of the present invention; and

FIG. 5 is a schematic showing of the controls for the auxiliary hot water circulating system of the present invention.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail, one specific embodiment, with the understanding that the present disclosure of the invention is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

A schematic drawing of a vehicular cooling system is shown in FIG. 1, in which water cooled engine 4 utilizes radiator 1, hot water circuit 2 and cool water return circuit 3. On most vehicles having a water cooled engine, an additional circuit, such as that represented by conduits 6-8-5 is provided with the vehicle so as to enable use of the vehicle's heater 11.

As can be seen, hot water transmitting conduit 6, in the absence of the present invention, connects directly to the hot water transmitting conduit 8 so as to enable transmission of the hot water from the engine through heater core 11, at which time fan 9, pushing air through core 11, transfers the heat 10 from heater core 11 into the vehicle itself. Vehicle water pump 30, operated by fan belt 31 connected to engine shaft 32, pumps the vehicle's water, when the engine is on.

Circulation device 7 has been interposed between hot water transmitting conduit 6 and hot water transmitting conduit 8 so as to enable flow from conduit 6 to conduit 8; and subsequently, through the heater in either one of two water circulation situations.

When engine 4 is running, and thus pumping water through conduits 6-8-11-5, electrically operated circulation device 7 is not activated, but merely passively enables the natural flow of the engine pumped water from conduit 6 to conduit 8 towards the heater with subsequent return of the water to engine 4. However, when engine 4 is shut off, hot water circulation device 7 is electrically activated by manual switch or automatic thermostat control and changes from its passive role of enabling pumped water to pass through it to that of an active pump, which will continue the transmission and circulation of hot water still present in engine 4 through hot water conduits 6-8-11-5. This provides circulation of hot water already in the engine through the heater 11 to enable the use of the heater, even when the engine is shut off.

At the same time the water that is used in the heater is pumped back to the still warm engine for reheating and recirculation through the heater. Through utilization of immersion heater H in circuit 3, prolonged indefinite use of heater 11 can be accomplished, even though engine 4 is shut off. In this situation, the coolant can be maintained substantially hot for use by heater 11 and circulated continuously to it by circulation device 7.

The circulation device 7 is an integrated pump motor device, such as shown in FIG. 2. Device 7 is comprised of motor housing 17, motor extension collar 10, pump chamber housing 15 and pump inlet cover 14. The preferred embodiment of the motor pump assembly 7 is a magnetically coupled centrifugal pump assembly 22, shown with input orifice sleeve 13 and output orifice sleeve 12.

A cross sectional view of magnetically coupled centrifugal pump assembly 22 is shown in FIG. 3, which in turn displays pump inlet cover 14, pump chamber housing 15 and input and output orifice sleeves 13 and 12, respectively. Motor shaft 21 extends into motor extension collar 10 towards the magnetically coupled centrifugal pump assembly 22 and has attached at its end cylindrical magnetic yoke 20.

Pump impeller blade 16 revolves in alignment with the revolutions of cylindrical yoke 20 attached to the electric motor, not through actual attachment of a continuous shaft from the motor, but rather through the magnetic force of yoke 20 being followed by magnetic base 23 of blade 16. Thus, pump chamber 24 is totally segregated and sealed from contact with any portion of the motor, the motor shaft 21 or magnetic yoke 20.

Upon entry of caustic, hot radiator water through input orifice 13, this liquid is segregated within pump chamber 24 and cannot drip down into vacant space 25. Thus, no seals, bearings, or the like, have been utilized or are needed to connect motor shaft 21 to rotating pump impeller blade 16. The lack of shaft packing lenghthens the life of the pump and reduces the power drain.

In one preferred embodiment of the invention the impeller magnet base 23 is removed from the main flow circuit that extends from input orifice 16, chamber 24, around blades 16 and out orifice 12a. The metallic particles normally found in the coolant of the cast iron engine, however, do not build up on the magnet 23.

A top elevational view of pump impeller blade 16 and impeller blade base 23 is shown in FIG. 4. Blade orifice 26 in the center of blade 16 enables the insertion of blade 16 over a spindle emanating from the bottom portion of the pump chamber itself, around which blade 16 revolves.

Means are provided for automatically operating both the circulation device 7 and the fan of the vehicle heater and for isolating the circulating system controls from the original temperature control circuits of the vehicle. More particularly, as shown in FIG. 5, a pair of relays K1 and K2 are provided. Relay K1 acts to control the power to circulating device 7, while relay K2 controls the power to fan motor 9.

Circulating device 7 is connected to the battery over a circuit that extends from the positive pole of battery 31 through fuse F1, conductor 32, thermostat 33, conductor 34, double-pole, double-throw center off switch S1, conductor 36, normally closed relay contact K1-1, conductor 37 through the motor of circulating device 7 to ground at 38. The energization circuit for the fan motor 9 extends from the negative pole of battery 31 through fuse F1, conductor 32, thermostat 33, conductor 34, switch S1 to current control circuit 41.

Means are provided for limiting the current through the fan. More particularly, current control circuit 41 is shown in this preferred embodiment as including an astable oscillator 42, such as provided by National Semi-Conductor Co. in their package LM555CN. The control circuitry 41 is connected through the low fan position or the high fan position of the switch S1. It should be recognized that other circuits could be used in place of the astable oscillator.

The low fan position of the switch is when the double-pole, double-throw armature contacts S1A, S1B connect to contacts S1-1 and S1-2, respectively. The high fan position includes contacts S1-1 and S1-2 connected to armature contacts S1A and S1B, respectively.

The astable circuit 42 provides an output pulse that effectively operates the fan motor. More particularly, the output pulse causes the emitter of transistor Q1 to also pulse. When the output of 42 goes low, the low is transmitted to the base of transistor Q1 over conductor 61 and biasing resistor R4. Responsive to the lows on the base of transistor Q1, operating current flows through the resistor to the fan motor 7 over a circuit that includes positive battery (coupled through conductor 37), conductor 62, conductor 63, transistor Q1, conductor 64, the load terminal of circuit 41, conductor 45, normally closed contacts K2-1, conductor 46 and fan motor 9 to ground.

The speed of the motor is controlled by varying the off time of the transistor Q1; i.e. the low output of the astable circuit 42. This is accomplished by varying the discharge time of capacitor C1 rather than by the energy consumptive use of resistors to vary the current flow. Capacitor C1 is coupled between the threshold input 6 of circuit 42 and ground. It is normally charged over a circuit that includes positive battery at the input of circuit 41, conductor 62, resistor R3 and diode D1.

When transistor Q1 conducts responsive to the oscillator output, then capacitor C1 discharges over a circuit that includes diode D2, conductor 66, terminal 2 of circuit 41, conductor 52, armature S1B to either the high or the low speed connections of switch S1. For the high speed connection, the circuit continues through contact S1-4, conductor 44, terminal 3 of circuit 41, conductor 67, and through resistor R2 to the discharge terminal 7 of circuit 41 which is low at this time.

When switch S1 is in the low speed position, then armature S1-B is coupled to contact S1-2, conductor 43, terminal 1 of control circuit 41, conductor 68 and through resistor R2 to the discharge terminal 7 of circuit 41. Resistor R2 is approximately twice as large as resistor R1; and therefore, the discharge time is longer by a factor of approximately two. The output of the astable oscillator at terminal 3 is positive during the discharge time of capacitor C1; and thus, the longer the discharge time the longer transistor Q1 is not conducting and the slower the fan motor.

The astable oscillator circuit has the following inputs: Terminal 1 is tied to ground over a circuit that includes conductor 69, the negative terminal of control circuit 41 and conductor 71 to ground; Terminal 2 is the trigger terminal and it is tied to threshold terminal 6 over conductor 72; The connection to the output terminal 3 has previously been discussed; The reset terminal 4 is coupled to positive battery through conductors 73 and 62; The control voltage terminal 5 is coupled to ground through timing capacitor C2; The connections to terminals 6 and 7 were previously discussed; The positive battery terminal is tied to positive battery over conductor 62; A regulating zener diode Z1 is attached between terminals 1 and 8. A filter capacitor C4 bridges the zener diode. Another filter capacitor C3 is attached between the emitter of transistor Q1 and ground.

The control circuit thus varies the fan speed in an energy efficient manner. The pump is also controlled by switch S1. When the switch is at either the high or the low setting, the pump operates as does pilot light P1. However, if the ignition switch is on, relays K1 and K2 operate and the pump and pilot light are disconnected from power, while the fan obtains its power over the regular circuitry.

In a preferred embodiment, the components have the following values:

R1 = 360K Ohms	C1 = 0.1 μfd.
R2 = 620K Ohms	C2 = .01 μfd.
R3 = 91K Ohms	C3 = 22 μfd.
R4 = 40 Ohms	C4 = 470 μfd.

The coils of relays K1 and K2 are joined together through conductor 49, which is tied to ground at 51. The other end of coils of relays K1 and K2 are joined together at 52 and from there to either the primary of the ignition coil or any other ignition on only power source through conductor 53. Thus, when the ignition is on, both relays K1 and K2 are operated, closing contacts K1-2, K2-2 and opening contacts K1-1 and K2-1. When contacts K1-1 is open, then circulating device 7 is de-energized. At that time, the vehicle pump is normally pumping the heat carrying fluid of the system through the heater.

At that time, with the ignition on, K2-2 contacts close, K2-1 contacts open so that the fan motor 9 is operated through conductor 54 connected to its normal control circuitry. When the ignition switch is off, then contacts K1-1 close to energize circulator device 7 and contacts K2-1 close to energize the fan motor through the current control circuitry 41.

Thus, to connect the improved circulating system for vehicle heaters, the lead to the fan motor 9 is removed from the fan motor connection and attached instead to the terminal connected to the movable contact of contacts K2-2. A lead 56 is connected to the negative voltage. A lead 53 is connected to the ignition coil primary or any other ignition on only source.

With the control circuit in place then circulator device 7 is operated any time the ignition is off until the coolant cools sufficiently to open thermostat 33. A switch may be used in series with thermostat and conductor 34 to enable an operator to manually disconnect the circulator device 7. Thus, the system with its control circuitry is isolated from the original temperature controls in the vehicle and further reduces the current drain caused by the operation of fan motor 9.

The foregoing description and drawings merely explain and illustrate the invention, and the invention is not limited thereto, except insofar as the appended claims are so limited, as those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention. The utilization of a centrifugal type pump assembly, for example, describes only one pump embodiment usable in the present invention, and the circulating system is not limited as to such.

I claim:

1. An energy-saving, pressurized hot liquid circulating system to circulate hot liquid from a liquid-cooled vehicle engine through the vehicle's heater, said vehicle of the type having an electric storage battery to energize certain of the vehicle's accessories, and having a hot liquid circulating system of the type including a radiator, engine liquid jacket, and said heater,

said system comprising:

means to pump said hot liquid through said vehicle heater when said engine is turned off,

said pump means receiving its driving power solely from said vehicle battery;

conduit means coupling said vehicle heater to said liquid jacket,

said pump means positioned in series with said conduit means intermediate said vehicle heater and said liquid jacket,

said pump means being of the centrifugal type having a motivating impeller driven responsive to the rotation of a drive shaft of an electrical motor,

means for magnetically coupling said motor shaft to drive said impeller,

said magnetic coupling means adapted to drive said impeller without requiring said motor shaft to pass through said conduit,

said impeller being mounted on an impeller shaft,

said impeller having a base magnet attached thereto,

said impeller being enclosed in a non-metallic casing,

said casing having a protruding portion for receiving said base magnet of said impeller,

said impeller shaft extending through said cylindrical magnet and said impeller; and

means for mounting said impeller shaft entirely within said casing to enable rotation of said magnetic coupling means about the outer periphery of said protrusion to thereby shorten the lines of flux between said base magnet and said magnetic coupling means whereby, when said motor shaft rotates, it more effectively causes said base magnet to rotate; and

means to control the operation of said vehicle fan and said pump means,

said control means including an electrical relay,

said relay operated responsive to the operating or non-operating of said engine,

first and second normally closed contacts on said relay,

said first contacts connected in series between said battery and said pump means, and

said second contacts connected in series between said battery and said vehicle fan,

said relay directing electrical current to said fan when said engine is non-operating,

said control means further including relatively, non-resistive intermittenly operating switching means to control the speed of said vehicle fan when said second contacts are closed, in order to minimize power drain of said battery,

said first contacts directing electrical current to said pump means to operate said pump means when said engine is non-operating.

2. The apparatus as recited in claim 1 including manual switch means to selectively complete a circuit between said fan means and said pump means to said battery,

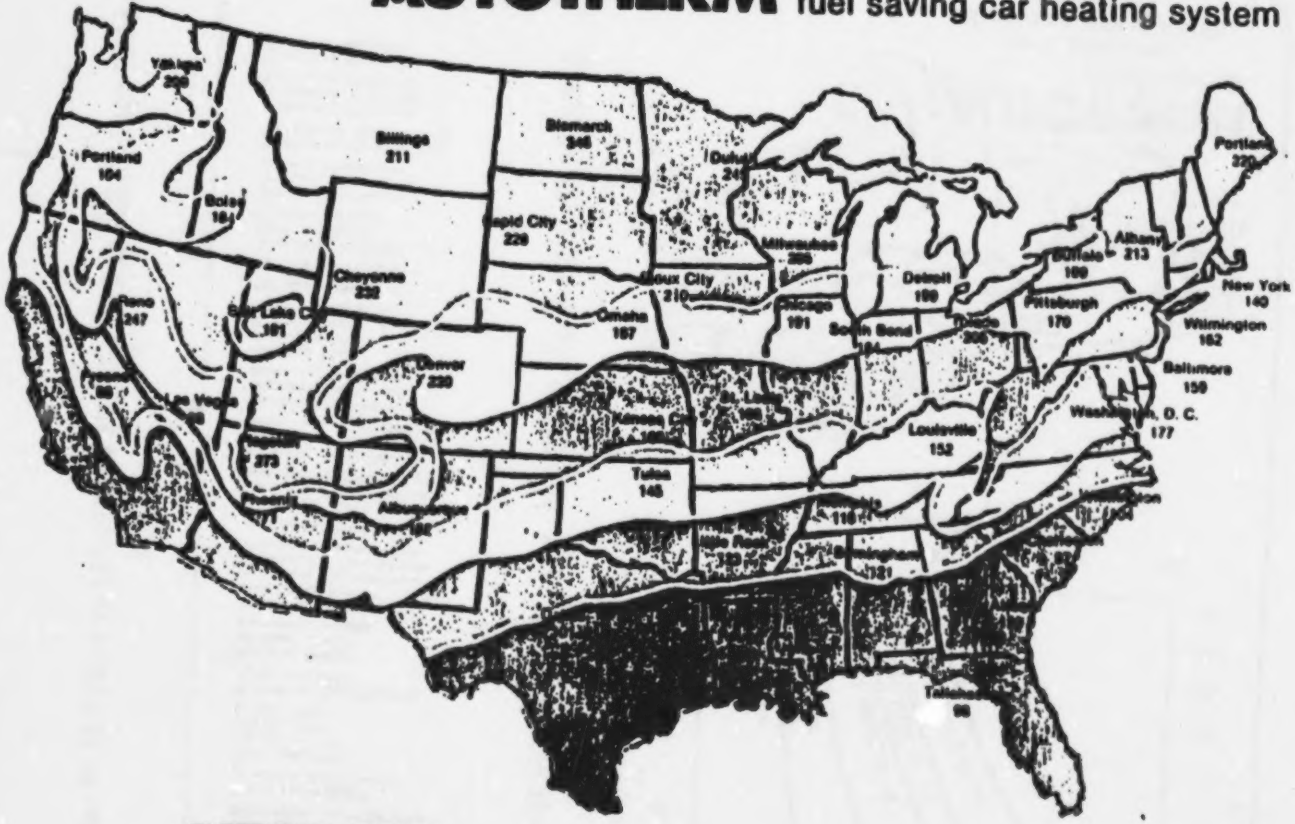
said fan speed control means includes means to control the current to said fan,

said fan spaced control means positioned intermediate said relay and said switch means.

* * * * *

ATTACHMENT B

AUTOTHERM® fuel saving car heating system


Yakima 200
Portland 164
Boise 184
Billings 211
Bismarck 246
Rapid City 226
Cheyenne 232
Salt Lake City 191
Reno 247
Las Vegas
Albuquerque
Denver 220
Omaha 187
Sioux City 210
Tulsa 145
Milwaukee
Chicago 191
South Bend
Detroit 189
Toledo
Louisville 152
Buffalo 189
Albany 213
Pittsburgh 170
Portland 220
New York 140
Wilmington 162
Baltimore 159
Washington, D.C. 177
Tallahassee 90

FLEET FUEL SURVEY

FIND YOUR LOCATION ZONE AND FIGURE YOUR SAVINGS WITH AUTOTHERM FUEL CONSERVATION SYSTEM*

	AVERAGE DAYS UNDER OPER PER WINTER SEASON	×	AVERAGE IDLE HOURS PER SHIFT	×	AVERAGE GALS FUEL PER IDLE HR.	=	AVERAGE GALS FUEL SAVED PER SHIFT PER SEASON	×	COST OF FUEL	×	NO. OF SHIFTS PER CAR	×	NO. OF CARS	=	TOTAL $ SAVED PER SEASON
▩	225		2.5		1.2		705		____		____		____		____
□	200		2.5		1.2		615		____		____		____		____
▨	180		2.5		1.2		540		____		____		____		____
	160		2.5		1.2		480		____		____		____		____
▦	120		2.5		1.2		360		____		____		____		____
■	90		2.5		1.2		270		____		____		____		____
YOUR DATA	____		____		____		____		____		____		____		____

*Acknowledged by National Bureau of Standards and U.S. Environmental Protection Agency as an effective fuel saving device.

IDLE CONSUMPTION FIGURES*

ENGINE DISPLACEMENT		FUEL CONSUMPTION PER HOUR AT IDLE*	ENGINE DISPLACEMENT		FUEL CONSUMPTION PER HOUR AT IDLE*
C.I.D.	Litres	Gallons	C.I.D.	Litres	Gallons
150	2.4	.5	300	4.8	1.0
200	3.2	.7	350	5.6	1.2
250	4.0	.9	400	6.5	1.3

*The figures given in this column are approximate averages. The actual figures will also vary based on factors such as: year and make of engine, carbureted or fuel injected engine, type of ignition system, type of air pollution equipment used on engine, idle speed, spark plug gap and condition, age and maintenance on vehicle, air and engine temperature, humidity and altitude of operation.

Copyright, AUTOTHERM, Inc., 1983
Printed in U.S.A.

Form No. IC181 5/81

ATTACHMENT C

The *AUTOTHERM Energy Conservation System* continues to circulate hot water from the engine block, through the vehicle heater . . . with the ENGINE OFF. This eliminates engine idle, safely maintains interior warmth, and saves $750 to $1.500 in fuel and maintenance costs per vehicle per year. The *AUTOTHERM Energy Conservation System* also increases vehicle service intervals and vehicle life and reduces air pollution and catalytic muffler burnout.

A small circulator, easily spliced into the heater hose, automatically continues to circulate engine coolant through the heater when the engine is turned off. The vehicle may be safely parked and locked while the interior keeps warm and windows and door locks stay free of ice and snow. The vehicle is ready to go on a moment's notice. When water temperature drops to 95° F., a thermostat automatically shuts off the AUTOTHERM system. This is beneficial during inclement weather when operators are absent from the vehicle.

The magnetic coupling eliminates shaft seals which wear and leak in pressurized cooling systems. The *AUTOTHERM Energy Conservation System* is guaranteed against leakage for the life of the original installation. It also results in low power drain from the limited supply of the battery, drawing less than one ampere of current to pump three gallons of water a minute. The vehicle circulating fan, normally left on low or medium once the vehicle is warmed, adds 6 to 7 amperes, but this is still not a significant power drain over the maximum heating time available. Heating time depends on outdoor temperature and engine size. Four hundred C.I.D. engines with heavy duty cooling systems keep interiors warm approximately 2-2½ hours at 32° F. At −15° F. and no wind, heating time will be about one hour.

Operation of transistorized communications systems, while the AUTOTHERM Energy Conservation System is in operation does not add substantially to the power drain. Vehicles equipped with strobe type emergency lighting can also be operated with the *AUTOTHERM Energy Conservation System* without any danger of discharging the battery.

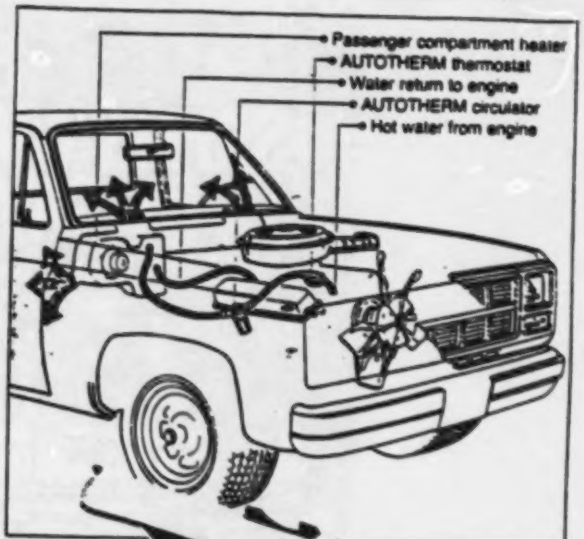
The new "T" or test version of the *AUTOTHERM Energy Conservation System* is often installed in test fleets or test vehicles to determine AUTOTHERM'S effectiveness as a conservation device. This effectiveness is measured by the SERVIMETER™ Hour Meter. The SERVIMETER logs the hours of AUTOTHERM use. This helps management monitor engine use, until the habit of idling while stationary is discontinued.

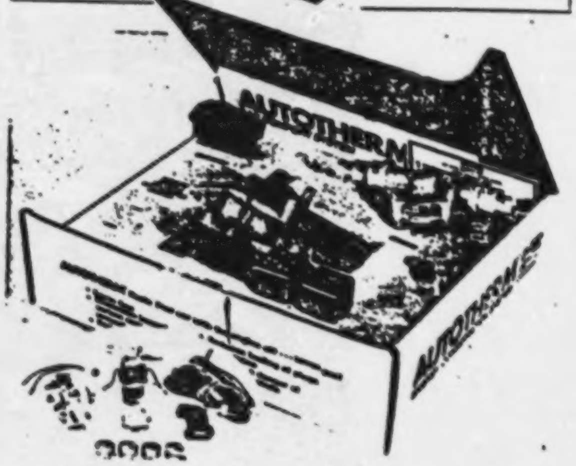
Drivers marooned in severe cold weather and snow, can survive for days with a full tank of gas by cycling the engine for five to ten minutes each time the *AUTOTHERM Energy Conservation System* shuts off—rebuilding the heat in the cooling system for another period of vehicle heating with the engine off.

The *AUTOTHERM Energy Conservation System* fits almost all water cooled vehicles except some models equipped with Automatic Temperature Control Air Conditioning. The system is complete and can be easily installed in less than one hour. It operates automatically and has an on-off switch to turn the system off during the summer months or when the vehicle is garaged for extended periods of time. A pilot light indicates system operation.

U.S. and Foreign Patents Pending and applied for.

© Copyright AUTOTHERM, Inc. 1980





The *AUTOTHERM Energy Conservation System* has been tested and is now used in thousands of federal, state, city, county and village vehicles throughout the U.S., Canada and Europe.

Write or call the factory direct or your local equipment distributor for further technical information, your own fleet fuel survey, a free demonstration, or Bulletin AM-HM-23-000.

Be prepared for winter with the *AUTOTHERM Energy Conservation System* (model 2100) or the *AUTOTHERM Energy Conservation System* with the SERVIMETER™ Hour Meter (model 2100 T).

AUTOTHERM® Sales Corp.

314 E. Main Street
Barrington, Illinois 60010
312/381-6366

AMFSB-36-1/82-25M

Printed in U.S.A.

Reproduced from
best available copy.

ELIMINATES IDLING
SAFELY MAINTAINS INTERIOR WARMTH
SAVES $750 to $1500 in

fuel and maintenance per vehicle per year

Be prepared for winter. Equip your vehicle with the

AUTOTHERM®

Energy Conservation System.

IDEAL FOR:

- Law-enforcement vehicles
- Taxicabs
- Automotive fleets
- Delivery vans
- Trucks
- Domestic and foreign cars
- Any vehicle with a water cooled engine

VEHICLE BENEFITS:

- Vehicles remain securely locked with the engine off, while the interior stays warm
- Windows and door locks are free of ice and snow
- No snow sweeping or ice scraping
- Vehicles are ready to go on a moment's notice
- A great advantage for: emergency calls, shift changes, or meal breaks

ENGINE ASSETS:

- Eliminates Spark Plug Fouling
- Increases Engine Performance Vehicle Life, and Oil Filter/Oil Change Intervals
- Reduces Air Pollution, Catalyti Muffler Burnout, and the Danger of Carbon Monoxide Poisoning

ATTACHMENT D

ENGINE IDLE - FUEL CONSUMPTION ANALYSIS

Organization: Example Study - C.P.D. Date: May, 1981

Address: 5219 S. Wentworth

Chicago, IL 60609

GALLONS CONSUMED PER HOUR @ IDLE: 1

Multiplied by

NUMBER OF HOURS @ IDLE PER DAY:
(Total all shifts) - Based on winter test: 10
1980-1981

Multiplied by

AVERAGE NUMBER OF FLEET IN DAILY SERVICE 2,520
(Total all shifts)

Multiplied by

DAYS OF HEATER OPERATION PER WINTER SEASON: 201

Multiplied by

AVERAGE COST OF FUEL PER GALLON: 1.20

Equals

TOTAL COST OF FUEL CONSUMED BY
FLEET IDLE TIME: $6,078,240 or
5,065,200 gallons

Minus

COST OF AUTOTHERM: $570,528

Equals

AVAILABLE FUNDS DUE TO CONSERVATION: * $5,507,712

* * * * * * * * * * * * (A 965% return on investme

FUEL CONSUMPTION RATES @ ENGINE IDLE R.P.M.

300 to 350 C.I.D. engines consume approximately
1.2 gallons per hour @ idle.

350 to 400 C.I.D. engines consume approximately
1.35 gallons per hour @ idle.

400 to 450 C.I.D. engines consume approximately
1.7 gallons per hour @ idle.

By: ______________________

Date:

* Note, this is for the first year, and doesn't indicate the additional savings available; multiplied by years of vehicle life cycle.

ATTACHMENT E

FINAL TECHNICAL REVIEW
Autotherm Car Comfort System
OERI No. 004641

Introduction

The "Autotherm Car Comfort System" was received for evaluation on November 21, 1978. It was processed through two first-stage reviews receiving favorable reports with regard to technical feasibility but showing some question with regard to energy savings. The submission was then sent to Chi Associates, Inc. for review at the second-stage level. This review was not definitive with regard to the energy saving potential, particularly with assessment of the data furnished by the inventor on the savings by a number of independent police groups. Additional review of the second-stage level was therefore requested of Mueller Associates, Inc. with emphasis on review of these data.

On November 15, 1979, the inventor met with OERI staff and demonstrated the components used in his system. I also discussed the invention with two members of the Michigan State Highway Patrol and examined the installation on their vehicle during a trip to Detroit on February 26, 1980; their reaction to the device was favorable and confirmed the performance claims of approximately 1 hours heat in a Ford vehicle having a 440 CID engine.

One of the most critical parts of this system is an energy efficient pump. A magnetically coupled pump has been developed for this purpose and a patent has been applied for this component.

The inventor's company has been awarded a contract, number GS-105-42687 for period 7-10-79 to 3-31-80 by General Services Administration. The Autotherm is listed in the Federal Supply Service catalog as FSG-25 under Manufacturing Code EVK-2000-1.

The inventor seeks funding to improve this product and reduce the cost so that it would have a larger potential market and afford a greater overall savings in actual fuel consumption.

Description

The "Autotherm Car Comfort System" is designed to provide heat in a vehicle during extended periods when the vehicle is not moving and the engine would normally be idling. This system allows the engine to be turned off while still supplying heat to the heater. The heat from the coolant in the engine block and the radiator is made available to the heater by means of an auxiliary pump, with the necessary controls for optimizing the available heating time. The system operates until the water temperature is reduced to the point where heat transfer becomes inefficient. In effect the heat from the engine in cold weather is therefore transferred to the inside of the vehicle instead of allowing it to be dissipated to the outside environment. Heating for periods up to 1 hour, depending upon outside temperature, engine, and coolant capacity, can be effectively obtained. This system therefore provides the means for saving the fuel which might be used during an hour of idling to maintain the heater operation in a parked vehicle.

The applications for this system are directed to those activities which normally have a requirement for heat in cold climates or weather conditions when the vehicle is not moving. Among the applications are:

1. Police and law enforcement vehicles
2. Taxicabs
3. Limousines
4. School buses
5. Utility vehicles
6. Delivery vehicles
7. Salesmen's vehicles
8. Government vehicles
9. Postal vehicles
10. Ambulances
11. Funeral vehicles
12. Recreational vehicles

Technical Discussion

The "Autotherm Car Comfort System" is a readily understood engineering design. However, the actual performance is confirmed only by testimonials from users and claims by the inventor. For this reason an abbreviated engineering analysis has been made to verify the performance claims.

The heat contained in the hot engine block and coolant system radiates to the exterior environment at the same time that it is used by the Autotherm System to heat the interior of the vehicle. Therefore, approximately half of the heat is available for heating the interior of the vehicle. For the following calculations a number of assumptions will be made. Small differences in these assumptions should not affect the conclusions appreciably.

Average passenger car volume = 96 cubic feet
Average passenger compartment size
  Height 41 inches = 3.5 feet
  Length 65 inches = 5.5 feet
  Width 60 inches = 5.0 feet

Surface area of windows, walls, roof, and floor
  2 x 5 x 5.5 = 55.0 square feet
  2 x 3.5 x 5 = 35.0 square feet
  2 x 3.5 x 5.5 = 38.5 square feet
Total Surface Area 128.5 square feet

Outside temperature = 32°F
Inside Vehicle Temperature = 65°F
Temperature Difference = 33°F

Conservatively, one may assume a heat transfer coefficient on the order of one Btu/hr - ft^2 °F, so

$$\text{Heat lost from vehicle} = 128.5 \times 33 \times 1 \frac{\text{Btu}}{\text{hr} - \text{ft}^{2\circ}\text{F}} = 4240 \text{ Btu/hr.}$$

Since the heat radiated from a person is approximately 480 Btu per hour it can be seen that even with two people in the car it is not possible to maintain the inside temperature of the car under these conditions.

The heat supply from the engine will depend upon the weight of the engine and the amount of coolant in the system. If the following assumptions are made:

Engine Weight - 500 pounds
Cooling System Capacity - 5.5 gallons
Radiator Temperature, Hot - 210°F
Radiator Temperature, Cold, at which Autotherm cuts off - 90°F
Temperature Difference of Coolant - 120°F
Specific Heat of Coolant - 1.0
Specific Heat of Cast Iron Engine Block - 0.12

then

heat available from coolants =

$$5.5 \text{ gal.} \times 8.4\#/\text{gal} \times 120^{\circ}\text{F} \times \frac{1 \text{ Btu}}{\#^{\circ}\text{F}} = 5500 \text{ Btu}$$

Heat available from engine block:

$$500 \text{ pounds} \times 0.12 \times 120^{\circ}\text{F} = 7200 \text{ Btu}$$

Total heat in engine and cooling system

$$5500 + 7200 = 12700 \text{ Btu}$$

Since only half will be available to the Autotherm

$$12700 \times \tfrac{1}{2} = 6350 \text{ Btu}$$

will be available.

This represents $\frac{6350}{4240} \times 1$ hour = 1½ hours of heat.

These calculations verify the claims of the inventor for time which the Autotherm can be effective in providing heat in the vehicle. This time will be affected by the outside temperature, wind, engine size, and coolant capacity.

Idling specific fuel consumption of 1.35 gallons per hour in a 400 CID engine is considered to be reasonable.

Conclusions

Autotherm is technically sound in concept and design, and should perform basically as claimed.

When installed on a vehicle of the appropriate class (listed earlier) its use should save fuel normally consumed in idling required to provide heat during the vehicle duty cycle in winter months. If used widely, total fuel savings could be significant on a national basis.

The system is already being sold and is being found to be cost effective. Widespread use is quite likely, particularly if provided Government support to improve market penetration.

Recommendation

Government support should include assistance in: redesign to reduce cost and consequently improve rate of market penetration; performance testing in appropriate vehicles representing segments of the vehicle population which can show the largest fuel economies; and marketing analysis to identify major segments of the vehicle population which would be potential users.

March 20, 1980
Date

Sidney Weiser
Sidney Weiser, NBS/OERI

ATTACHMENT F

AUTOTHERM
Sales Corp.
314 E. Main Street
Barrington, Illinois 60010

AUTOTHERM®

ENERGY CONSERVATION SYSTEM

A MAJOR CONTRIBUTOR TO SIGNIFICANTLY LOWER VEHICLE FLEET OPERATING COSTS

FLEET FUEL SURVEY

Prior to the development of the *AUTOTHERM* Energy Conservation System, vehicles operating in winter had to keep engines running while standing in order to operate vehicle heaters. Police vehicles, while on radar patrol, booking prisoners, shift changes, or on undercover surveillance have to idle engines in order to operate heaters and keep interiors warm. In many instances, vehicles are left parked with engines running in violation of vehicle ordinances or department regulations, while their occupants are absent performing their extra-vehicular duties, leaving these vehicles vulnerable to theft or run-away conditions. Taxi cabs, delivery trucks, utility trucks and supervisory vehicles, any vehicle driven as part of an occupation requiring continuous or repetitive vehicle use need to idle to keep interiors and personnel warm in cold weather.

With today's emphasis on conservation and the need to reduce rapidly escalating fuel budgets, eliminating idling can save hundreds and sometimes thousands of dollars per vehicle per winter season. The installation and USE of the *AUTOTHERM* Energy Conservation System eliminates the need to idle while standing just to keep warm, reducing fuel costs 15 to 50% depending on vehicle and vehicle use. This Fuel Survey will assist in the analysis of your fleet, helping you to prove to yourself, as it has to hundreds of others, that installation and USE of the *AUTOTHERM* Energy Conservation System is so cost effective, you can pay for it out of current fuel budgets *without* the need for special appropriations. There are thousands of vehicles and fleets around the world that have evaluated and are now using the *AUTOTHERM* Energy Conservation System because it is the most cost effective product developed in recent years for automotive use.

WHAT THE *AUTOTHERM* Energy Conservation System DOES

The *AUTOTHERM* Energy Conservation System consists of a simple low cost, easy to install system to continue circulation of hot water through the vehicle heater as if the engine were running but with the engine off. One model fits all 12 volt water cooled vehicles, new or old, foreign or domestic, car, truck, van, or recreational vehicle. The heater controls and fan are operated as normal. No adjustment in temperature setting or fan speed is required. With the *AUTOTHERM* switch on, operation is automatic. The engine is simply turned off with the ignition key each time the vehicle is stopped for more than a minute. The heater continues to operate the same as if the engine were running. It is again automatically turned off when the engine is restarted.

Vehicles can be left parked and securely locked, with the key removed, while they are kept warm for extended periods of time. This is an advantage during shift changes, booking of prisoners, investigations, lunch breaks, since the vehicle interiors can be kept warm with windows free of ice and snow ready to go on a moment's notice.

HOW THE *AUTOTHERM* Energy Conservation System WORKS

The *AUTOTHERM* Energy Conservation System circulator is a small, magnetically coupled 12 volt pump that is easily installed on any water cooled vehicle simply by cutting the inlet or outlet hose from the passenger compartment heater and splicing in the *AUTOTHERM* Energy Conservation System circulator. The stepped circulator nipples accommodate to all hose sizes so one model fits all vehicles from compacts to trucks.

The magnetic coupling is significant. It means there is no motor shaft seal between the motor and the pump impeller. Instead, a magnet on the motor shaft magnetically couples the motor's torque through a solid wall of plastic to a magnet on the impeller, turning it at virtually 100% efficiency. This has two major benefits. First, it eliminates all possibilities of coolant leakage in a pressurized cooling system. Seals wear and eventually leak. The *AUTOTHERM* Energy Conservation System circulator has no seals to wear and leak. Secondly, the magnetic coupling with its high torque transfer efficiency, permits the use of a small electric motor that draws less than one ampere of current from the limited source of the car's battery to pump three gallons of hot wate a minute. This low power consumption allows the *AUTOTHERM* Energy Conservation System circulator to operate without the hazard of running your battery down. A pump with a seal would require a motor three times as large to do the same job with a corresponding increase in power drain from the vehicle battery.

The *AUTOTHERM* Energy Conservation System will not run an emergency vehicle battery down because the combined current consumption of 4 to 7 amperes when the heater fan motor is set at low or medium speeds added to the less than one amp of the circulator pump and multiplied by the maximum number of heating hours of, let's say three hours, adds up to only 24 amp hours of power consumption from batteries with ratings of 55 to 88 amp hours. This leaves plenty of power for restarting, operation of blinker lights and transistor radio communication equipment. In many instances, even the lower power consumption strobe beacons can be operated with little hazard of reduced battery power, especially in emergency vehicles that are equipped with heavy duty batteries. The colder the outside temperature, the shorter the running time, the lower the power consumption from the battery leaving more for restarting.

Maintenance free batteries (those requiring no addition o water) have been a problem in general and the *AUTOTHERM* Energy Conservation System should not be blamed when these batteries fail. All fleet vehicles, especially those used for law enforcement work, should be ordered with heavy duty, deep discharge batteries as a matter of routine. Anything less, is false economy

WHAT IS THE *AUTOTHERM* Energy Conservation System?

The *AUTOTHERM* Energy Conservation System consists of four components: the *AUTOTHERM* Energy Conservation System circulator, control switch and indicator light, a thermostat for automatic operation to keep the vehicle interior warm while the driver is absent from the vehicle and, to give fully automatic operation, two relays. A plug-in wire harness to interconnect the components, complete pictorial instructions and all necessary hardware such as screws, wire ties, and hose clamps are also included.

These components are packaged as a kit especially developed for emergency vehicles and fleet users, and will keep the occupant warm with the engine turned off or keep the interior warm while the driver is absent and the vehicle securely locked. The thermostat will automatically turn the circulator and car fan off when water temperature drops to approximately 95°F., thus eliminating any chance of a run down battery should the driver not return to the vehicle while heating is still taking place. When he does return, the vehicle is started and the heater operated the same as a standard vehicle without the *AUTOTHERM* Energy Conservation System.

The two relays make operation fully automatic with no thought required to turn the *AUTOTHERM* Energy Conservation System on and off every time the vehicle is started and stopped. The driver merely turns the ignition switch off when he stops the vehicle for longer than a minute and the relays in the system automatically turn on the *AUTOTHERM* Energy Conservation System. When the engine is restarted, the relays automatically turn the system off to conserve circulator motor brush life. This automatic system allows police and other emergency vehicle operators to give full attention to the task at hand.

No adjustment in temperature setting or fan speed is required from that already set in the heater system of the vehicle by the driver for the comfort level currently required by him. However, when the vehicle is occupied for long periods of time, such as in surveillance work, it may be necessary, towards the end of the heating period, to increase the heater temperature setting in order to obtain longer comfortable heating periods prior to automatic turn-off.

WHERE THE *AUTOTHERM* Energy Conservation System CAN BE OBTAINED

The system is available to fleet vehicle operators from local law enforcement equipment dealers, select automotive distributors, and direct factory representatives trained to give dealers and customers sales and operational support. Technical support is also available direct from the factory and can be called on for consultation or assistance on any matter pertaining to the purchase, installation or use of the *AUTOTHERM* Energy Conservation System. Factory training personnel will be sent on request into the field for training local installers.

Following, we reprint the answers to typically asked questions regarding the *AUTOTHERM* Energy Conservation System, its performance, installation and use.

At the back of this brochure you will find a simple and easy to use fuel cost survey that will help you and your department to arrive at an actual dollar figure of what kind of saving in fuel you can expect when you install the *AUTOTHERM* Energy Conservation System on *YOUR* fleet. These are direct, measurable savings in fuel dollars.

There are additional savings included in this survey that are just as real in dollars and cents and which you may wish to include. These are, longer spark plug life, longer oil and filter change intervals, longer periods between tune-ups and significantly longer vehicle service life — and all this while providing your men with added comfort, safety and efficiency.

Though we've attempted to make this brochure as comprehensive and complete as possible, there may be questions we have not answered. If our other publications do not contain the information you are looking for, please feel free to call your local dealer, our field sales representative, or the factory direct.

HOW LONG WILL THE *AUTOTHERM* Energy Conservation System HEAT A VEHICLE?

This depends mainly on two things, the outdoor temperature and the size of the engine (cooling system.) Sun, wind, and size of vehicle interior also have some bearing but less than size of engine and outdoor temperature. The average American V-8 car will stay warm for one to one and a quarter hours at 32°F. outdoor ambient. A small 4 cylinder engined car, such as a VW Rabbit or Pinto about 30-45 minutes, while a large cubic inch engined car equipped with a 460 c.i. interceptor engine, will stay warm about 2 to 2½ hours.

At 15°F. below zero, the average American V-8 will stay warm for about thirty minutes. The four cylinder about ten minutes, the large interceptor V-8 about one hour. This shows the tremendous amount of residual heat energy available in the vehicle's engine cooling system; heat energy that has never been tapped before; energy that can now save fleet vehicle operators susbstantial amounts of fuel and maintenance dollars and help conserve a dwindling natural resource. The above figures are based on engine sizes within standard passenger cars. Optional heavy duty cooling systems with larger coolant capacities will give proportionally longer heating periods.

Vehicles used for surveillance work can get extremely long periods of vehicle occupancy with the *AUTOTHERM* Energy Conservation System simply by restarting the engine when the *AUTOTHERM* Energy Conservation System shuts off. This reheats the engine coolant in 5-10 minutes, giving another extended period of vehicle heater operation.

SOME FREQUENTLY ASKED QUESTIONS REGARDING THE *AUTOTHERM* ENERGY Conservation System AND ITS USES

1. Does the fan have to be used to make the *AUTOTHERM* Energy Conservation System work?

A. Yes

2. If the *AUTOTHERM* Energy Conservation System can keep vehicles warm for up to three hours, how come it won't run the battery down? How about real cold weather?

A. The *AUTOTHERM* Energy Conservation System pump itself consumes less than one ampere of current to continue circulation of water. The only other power consumed is in the fan and on most vehicles, at suggested low or medium speed, it consumes at most an additional 5 to 7 amperes and in most vehicles only 3 to 5 amperes. In a relatively small 55 ampere hour battery, one hour's worth of running would consume only 6-8 ampere hours, leaving plenty for restarting the vehicle. The colder the weather, the shorter the operating time and, therefore, less power is consumed from the battery.

3. Won't using the *AUTOTHERM* Energy Conservation System cool my engine down making restarting in cold weather harder?

A. No, the water temperature is cooled only to about 90°F. after which the water is unable to impart sufficient heat to the interior air to make it comfortable. The engine is never cooled down to ambient temperatures by use of the *AUTOTHERM* Energy Conservation System.

4. With this automatic system, when the thermostat shuts off, do you mean it shuts off the pump and heater fan? How can I use the fan for window defrost when I get back into the car?

A. Yes, it shuts the entire system off. When you get back into the car, the fan, the entire heater works as in a normal, non-*AUTOTHERM* equipped car including availability of defrost and/or heater fan when the engine is restarted.

5. What effect does wind and sun have on the length of time I can keep warm?

A. Considerable effect. The sun will help to keep the interior warm even on cold days. If you must occupy your vehicle and need maximum heating time, we recommend you park in the sun with the engine facing out of the wind or blocked from the wind by hedge rows or walls or fences or other parked cars.

6. My car is a big deluxe model with the automatic temperature control heater. Will the *AUTOTHERM* Energy Conservation System work on such a car?

A. No, the 2100 is not designed for installation or use on such vehicles without modification of the electrical circuitry in both the car and the *AUTOTHERM* Energy Conservation System. A model especially designed for such installation will shortly be available.

7. You call the *AUTOTHERM* Energy Conservation System a proven system. Seems to me to be pretty new?

A. It has been under test and extensive use for four years throughout the world.

8. How can you claim the *AUTOTHERM* Energy Conservation System is a major fuel saver? I've heard of a lot of gas saving gadgets and very few if any work.

A. The *AUTOTHERM* Energy Conservation System is a proven fuel saver since an engine that doesn't run does not burn gas. Idling an engine is a fuel waster since it burns the equivalent of traveling at a fairly good speed without propelling the vehicle. When you are idling your mileage is 0.0 MPG.

9. I have a van that's cold in the rear. Will the *AUTOTHERM* Energy Conservation System help me warm this area?

A. No. The *AUTOTHERM* Energy Conservation System in and of itself does not create heat. If your vehicle's heating system is insufficient to keep the interior of the vehicle comfortable, the *AUTOTHERM* Energy Conservation System will not help.

10. I have a Diesel car. Can I use the *AUTOTHERM* Energy Conservation System?

A. Absolutely, the *AUTOTHERM* Energy Conservation System works on any water cooled internal combustion engine, including the rotary Wankel engine.

11. My van has a rear heater. Will the *AUTOTHERM* Energy Conservation System work on a rear heater? Do I need one for both heaters?

A. Most two heater equipped vehicles have a common "Teed" connection into one hose going to and from the engine. If the *AUTOTHERM* circulator is installed into this common hose, both systems will have hot water circulated to them. Fan electrical circuit supplies must also be commoned into the system for proper function.

12. My car heater is just not capable of heating my car to a comfortable level. Will installation of the *AUTOTHERM* Energy Conservation System help?

A. Again, no. The *AUTOTHERM* Energy Conservation System merely lets you operate your vehicle heater the same as it operates when engine is running when the car is being driven or idled.

13. I have a van with a completely carpeted interior that's nice and warm while I'm driving. How long a period of heating time can I expect with the *AUTOTHERM* Energy Conservation System installed?

A. On the average, because of your better insulation, approximately the same as that of a passenger car equipped with the same size engine. Even though your interior volume might be larger, the superior insulation helps retain heat.

14. You say the *AUTOTHERM* Energy Conservation System could save my life. How's that?

A. Idling an engine while it is occupied is never a safe thing to do for any extended period of time. Defects in door and body seals and exhaust systems could cause the entrance of carbon monoxide into the passenger compartment. Installing the *AUTOTHERM* Energy Conservation System circulator and running the engine for five to ten minutes after the *AUTOTHERM* Energy Conservation System shuts off, a vehicle interior (with a full tank of gasoline) could be kept warm for several days keeping its occupants from freezing or becoming asphyxiated.

15. I have a small motor home. Of what use is the *AUTOTHERM* Energy Conservation System? I've got a propane furnace and it only takes a couple of minutes to jump out and light the furnace pilot.

A. During many short stops, the *AUTOTHERM* Energy Conservation System can provide the necessary interior warmth. For fueling and dumping, shopping, setting up camp, or eating at the roadside, the *AUTOTHERM* Energy Conservation System can keep the interior of small motor homes comfortably warm without the need to light the furnace pilot.

16. We're a utility and operate a very large fleet of service and installation vehicles. Our rules forbid the drivers to occupy the vehicles and run the engines to stay warm. We want them to work so why so should we install the *AUTOTHERM* Energy Conservation System and encourage them to break company rules?

A. Anyone driving a vehicle for work will have occasion to have to stop and occupy that vehicle for report writing, and other functions. They also will want to keep this interior warm while the vehicle is parked at the location where the service is being performed, at coffee and lunch stops. People being people, they will want to stay warm or want to have a warm vehicle to return to, especially during extremely cold weather. With the *AUTOTHERM* Energy Conservation System they no longer will have to disobey vehicle codes that forbid idling while the driver is absent.

17. Our police cars are equipped with 2-way radios. Isn't this a drain on the battery that, along with the *AUTOTHERM* Energy Conservation System, will run my battery down?

A. Again, no. Modern transistorized two-way radios consume very little power on stand-by or while in the receiving mode. The short duration of broadcasting has very little effect on battery drainage and when added to the power consumption of the *AUTOTHERM* Energy Conservation System circulator and heater fan, the drain on the battery is very little; especially when compared to the added capacity of the heavy duty battery systems found on law enforcement vehicles.

18. Explain how police departments can have special benefits and major cost savings with the use of the *AUTOTHERM* Energy Conservation System.

A. Regular patrol vehicles frequently are required to stop while on radar patrol, observing traffic, or other patrol situations, shift changes, while the officer is booking a suspect, investigating an accident scene or other disturbance. All of these functions result in long idling hours on patrol engines. Our surveys indicate that some vehicles idle up to 30 to 40% of the time. These larger displacement engines consume significant quantities of fuel while idling. The *AUTOTHERM* Energy Conservation System can reduce this fuel consumption, saving police departments substantial amounts of money previously used for fuel that can now be allocated to purchasing other law enforcement equipment. The fleet fuel survey sheet can show you specifically what these savings would amount to and they turn out to be quite impressive.

The benefits of installing the *AUTOTHERM* Energy Conservation System on undercover vehicles is in addition to the above in that these vehicles can be occupied and kept comfortable for long periods of time without the necessity of attracting attention to the undercover vehicle by an idling engine and exhaust vapors.

19. I can see where our mobile intensive care ambulance could benefit from the use of the *AUTOTHERM* Energy Conservation System to keep the interior warm and ready at an accident or heart attack scene, but we're afraid we might not be able to restart the vehicle and get the patient to the hospital, so we keep the engines running.

A. Emergency vehicles that idle a great deal foul the engine and the spark plugs to the point where restarting becomes difficult because of the long idle time. With the *AUTOTHERM* Energy Conservation System installed, fouled spark plugs and other engine deterioration between tune ups is eliminated and the chances of restarting such an engine are much better than on idled engines.

AUTOTHERM ENERGY CONSERVATION SYSTEM
FUEL SURVEY

Name of Fleet ______ Survey Date ______

Address ______ Maintenance Garage Address ______

City ______ State ______ Zip Code ______ ( ) Telephone ______

Individual Contacted ______ Position & Title ______

Person Making Survey ______

IDLE CONSUMPTION FIGURES*

ENGINE DISPLACEMENT		FUEL CONSUMPTION PER HOUR AT IDLE*	ENGINE DISPLACEMENT		FUEL CONSUMPTION PER HOUR AT IDLE*
C.I.D.	Litres	Gallons	C.I.D.	Litres	Gallons
100	1.6	.4	300	4.8	1.0
150	2.4	.5	350	5.6	1.2
200	3.2	.7	400	6.5	1.3
250	4.0	.9			

* The figures given in this column are approximate averages. The actual figures will also vary based on factors such as: year and make of engine, carbureted or fuel injected engine, type of ignition system, type of air pollution equipment used on engine, idle speed, spark plug gap and condition, age and maintenance on vehicle, air and engine temperature, humidity and altitude of operation.

1. Gallons consumed per hour at idle: .... ______

2. MULTIPLIED by number of hours of idle per vehicle, per day, all shifts .... ______ .... EQUALS ______ Gallons of fuel consumed per day, per vehicle

3. MULTIPLIED by average number of vehicles in daily use, all shifts .... ______ .... EQUALS ______ Gallons of fuel consumed idling per day, by fleet

4. MULTIPLIED by days of heater operation per winter season in your area .... ______ .... EQUALS ______ Gallons of fuel consumed idling by fleet each season

5. MULTIPLIED by average cost of fuel per gallon .... $ ______ .... EQUALS $ ______ Cost of fuel consumed by fleet each season by idling

6. MINUS cost of AUTOTHERM Energy Conservation System .... (A) $ ______ .... (B) EQUALS $ ______ Net saving first year by eliminating idling.

7. MULTIPLIED by life cycle of fleet .... ______ years .... EQUALS $ ______ Total savings attributable to eliminating idling during fleet life cycle.

8. Divide Line 6 (B) by Line 6 (A) .... EQUALS ______ percent Percentage of return on investment — FIRST YEAR

9. Additional savings attributable to elimination of idling:

Extended oil filter and oil changes $ ______

Extended spark plug life $ ______

Extended tune up intervals $ ______

Extended vehicle life cycle $ ______

©Copyright, 1981

AUTOTHERM, Sales Corp.
314 E. Main St.
Barrington, Il. 60010
Printed in U.S.A.

Form No. AM-SB-EV-F-9-001 11/81-5M

ATTACHMENT G

AUTOTHERM®, Inc.

ENERGY CONSERVATION SYSTEMS

AUTOTHERM® SALES CORP.
314 E. Main Street
Barrington, Illinois 60010
(312) 381-6366

LIST PRICE SHEET
EFFECTIVE Sept. 1, 1983

COMPLETE KITS

PART NUMBER	DESCRIPTION	QUANTITY	LIST PRICE
2100	AUTOTHERM Energy Conservation System	1 - 4	$172.70
		5 - 24	168.56
		25 - 49	163.81
		50 - 99	161.00
		100 - 249*	155.25
2100-T	As Above with One SERVIMETER	1 - 4	198.90
		5 - 24	194.75
		25 - 49	189.69
		50 - 99	186.88
		100 - 249*	180.88
2100-TT	As Above with Two SERVIMETERS	1 - 4	225.13
		5 - 24	220.94
		25 - 49	215.63
		50 - 99	212.63
		100 - 249*	206.56

PARTS

1000	AUTOTHERM Circulator Pump	Each	$ 94.56
1029	Wire Harness	Each	34.70
1034	Toggle Switch	Each	6.44
1038	SERVIMETER	Each	36.79
1041	Thermostat	Each	15.66
1057	Mounting Hardware Kit	Each	8.49
1059	Relay	Each	9.29
1078	Installation & Owner's Manual	Each	.75
1092	LED Indicator Light	Each	5.86

* Quantities of 250 or more will be quoted on request.

PRICES: Prices and specifications are subject to change without notice. The possession of this price list by any person in not to be construed as an offer to sell him or anyone else goods listed therein at the prices stated.

TERMS: Orders accompaniedy by payment in full shall be entitled to a two percent (2%) discount on net invoice and shipping charges will be prepaid and allowed by factory. Prepayment on blanket orders can be made by sending check for discounted correct amount for each release. It is not necessary to prepay entire order to qualify for prepayment discount. Prepayment means checks or money order received with order or release. Any other means of payment such at "payment upon receipt of shipment", Letters of Credit, etc. shall NOT be deemed as prepay and, therefore, are NOT entitled to discount. Checks will be returned if orders cannot be delivered within 10 working days after receipt of order and check. With approved credit, terms are Net 30 days. Unpaid invoices over 30 days will be billed 1½% additional per month on the unpaid balance. Users not promptly paying the 1½% late charge fees or whose accounts go over 90 days will be permanently placed on a cash-with-order basis. Those having been placed on a cash-with-order basis will not be entitled to the 2% discount on subsequent orders where payment is tendered with order.

DELIVERY: Shipping point is F.O.B. Barrington, Illinois. Freight is prepaid and billed to issuer of purchase order. No drop shipments will be made. No requests for split shipments on quantities of less than 200 will be honored except when initiated by factory due to back order delivery situations. Shipments under 100 lbs. to a single location shipped United Parcel Service. Orders over 100 lbs. shipped split UPS at factory option or freight cheapest way. Factory reserves the right to make partial shipments on all orders. With credit approval, orders will be accepted for delivery based on availability at the time of receipt of order. All orders for quantities of 100 pieces or less will be delivered withing 10 to 15 working days, plus shipping time, after credit approval or you will be immediately notified of any longer delays. Larger orders subject to production delays. Firm delivery dates will be confirmed in writing within 10 to 15 day plus mailing time after receipt of order by factory provided credit has been approved. Otherwise notification of delivery shall be within 10 to 15 working days after credit approval.

ORDERS: Users of AUTOTHERM Sales Corp. products may place orders for units direct with the factory or through select law enforcement equipment dealers who stock, service, and sell our products. Direct factory sales representatives are available in many key areas who have been specifically trained at the factory to assist users in demonstration, fleet analysis, test installation, product performance, evaluation, sales and service of all of our products. Contact factory for your nearest dealer or representative.

BLANKET ORDERS: Blanket orders will be accepted from users, placed direct with factory or through dealers provided that:

1. Purchaser's order is written and addressed to AUTOTHERM Sales Corp.
2. Entire order is taken within six months from date of order.
3. Releases number only four and are in multiples of 5 units.
4. Order is for at least 200 units.
5. Firm releases dates for the entire order accompany the original purchase order. Dates cannot be changed or order cancelled once accepted by factory.

GOVERNMENTAL CONTRACT AND BID PURCHASES: AUTOTHERM Sales Corp. solicits and encourages federal, municipal, county and state governmental bodies to submit bid requests for contract purchases direct with the factory. Such bid requests may be placed with the factory through its dealers or direct factory representative who will then receive credit as the factory's agents for such sales. Please request factory quotes for quantities above those shown on this price sheet.

RETURN GOODS: Materials will not be accepted for credit without written consent regardless of reason for return.

GUARANTEE: New AUTOTHERM Energy Conservation System components and accessories are guaranteed direct to installing fleets against defects in material and workmanship. Any single unit or component may be returned for repair or replacement without prior written permission, if properly packaged along with an explanatory note and postpaid to AUTOTHERM Sales Corp. 314 E. Main Street, Barrington, Illinois 60010. The selling dealer is authorized to extend this guarantee for single units or components direct to fleet user. Claimed defects for more than a single unit or component must have written factory permission before return. Users are requested to return for replacement or credit only units that are within the warranty as date coded at time of manufacture. We endeavor to produce only quality products, therefore, we will accept for examination purposes only, without incurring any other obligation therein, and subject to our sole discretion, defective units that are out of warranty, and are returned postpaid. Major components have serialized production codes identifying production dates. Please give these numbers when calling or corresponding.

LIMITED PRODUCT WARRANTY

The AUTOTHERM Energy Conservation System is warranted as follows:

To be free of defects in workmanship and material (except fuses and light bulbs) for a period of twelve months as determined by date codes and/or serial numbers stamped on the product at the time of manufacture.

That for the life of the original installation, your AUTOTHERM Energy Conservation System circulator will never leak engine coolant.

Defective units or parts returned directly to the factory address on this certificate, properly packaged and prepaid, will be replaced or repaired, at the company's discretion, where examination by its engineers confirms defects in material and workmanship. The company shall be the sole judge of such defects and its determination shall be final. The guarantee does not cover failures or defects which in the company's opinion are caused by abuse, accident, improper use of or failure to follow use and installation instructions currently published. The extent of the liability of AUTOTHERM Sales Corp. shall for any reason be limited to twice the original purchase price of the AUTOTHERM Energy Conservation System circulator unit or part being returned for inspection and service. This document represents the only guarantee and no other guarantee is intended or implied. The company assumes no responsibility for damages due to interpretation of material in such instructions nor to errors or omissions which they may contain for time to time. Employees, Representative Agents, or Dealers cannot extend or modify, verbally or in writing, the guarantee stated herein.

Workmanship and materials supplied by the installer or dealer that are not part of the company's products or its replacement are guaranteed by the installer or dealer. AUTOTHERM Sales Corp. shall not be liable for, nor guarantees, the labor, workmanship, or materials supplied by others.

There are no warranties, express or implied, made by the seller or supplier which extend beyond the description on the face hereof. All warranties herein stated are expressly in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose. Buyer's sole and exclusive remedy for breach of all warranties pertaining to the goods shall be the repair or replacement of any defective parts thereof due to faulty workmanship or construction.

AUTOTHERM Sales Corp.

FORM# L-1-005-9/83

314 E. Main Street, Barrington, IL 60010

Copyrighted . 1981 AUTOTHERM Sales Corp. Barrington, IL 60010

Printed in U.S.A.

ATTACHMENT H

AUTOTHERM®

AUTOMOTIVE ENERGY CONSERVATION SYSTEM

INSTALLATION and OWNER'S MANUAL

FOR ALL CURRENT AUTOTHERM

ENERGY CONSERVATION SYSTEMS

I PARTS

The Standard AUTOTHERM Energy Conservation System is supplied with the following parts:

- AUTOTHERM Circulator
- AUTOTHERM Thermostat
- (2) 12 V SPDT Relays
- Toggle Switch and Pilot Light *or*
  Lighted Rocker Switch
- Main Wire Harness
- Red Wire and Fuseholder Assembly *or*
  - Circuit Breaker
  - Short Red Wire
  - Long Red Wire
- Hardware Bag with the following:
  - (4) Hose Clamps
  - (4) #8 x 5/8 Self-tapping Screws
  - Cable Ties
  - (2) Tubular Splice Connectors
  - (1) Eyelet Terminal
  - (1) Tap Connector for larger wire
  - (1) Tap Connector for smaller wire
  - (1) Wiring Grommet
- AUTOTHERM identification decal
- User Instruction decal or card
- Other items included as necessary

II TOOLS

The following tools are recommended for the installation:

- Drill motor
- 1/2" (12.5 mm) drill
- 9/64" (3.5 mm) drill
- 5/16" (8 mm) drill
- 3/8" (9.5 mm) drill
- (2) Vise-grip pliers or (2) C-clamps &
  1 pair pliers
- Sharp Knife
- Screwdriver or 5/16" Socket & Rachet
- D.C. Voltmeter** or 12 V Test Lamp
- Wire Cutter & Stripper
- Crimp Tool for Electrical Terminals
- Flat File (Rectangular Switch Only)

** *A V.O.M. (Volt-Ohm-Milliamp Meter) will be very useful in locating key points in the vehicle electrical circuit as well as in trouble shooting. For voltage checks hook negative (common) lead to vehicle engine or sheet metal and positive lead to point in question.*

III INSTALLATION

IF YOU READ NOTHING ELSE, AT LEAST READ THIS —

DON'T install circulator or thermostat near exhaust manifold or other heat source.

DON'T install circulator or thermostat in the way of dip sticks, spark plugs, and other service items.

DON'T install circulator above coolant level in coolant system. Circulator will not work.

DON'T install circulator with its arrows pointing against direction of coolant flow with engine running.

DON'T install thermostat in heater outlet hose; or any further than necessary from engine block.

DON'T bend terminals of thermostat when making electrical connections.

DON'T splice into fan circuit at fan motor. Circuit must be broken on HOT side of heater control unit.

DON'T allow vehicle to go back into service with fan running at high speeds only (when in AUTOTHERM mode).

DON'T use greater than 70% antifreeze in the vehicle coolant mixture. It adversely affects the life of the circulator and thermostat.

DON'T use AUTOTHERM system with heater/air conditioner control in Max A/C, A/C, or Defrost (demist) modes.

DON'T skip reading instructions.

1. Read instructions through.
2. Feed longest bundle of wire harness (marked #2 with RED and BROWN wires) from passenger compartment through firewall into engine compartment.
   a. Remove tape and uncoil main wire harness.
   b. Set aside loose BLACK wire.
   c. Check relay plug wiring. Orientate relay plugs as shown below with wires coming out towards you. Check the number and color of wires into each plug with the diagram below.

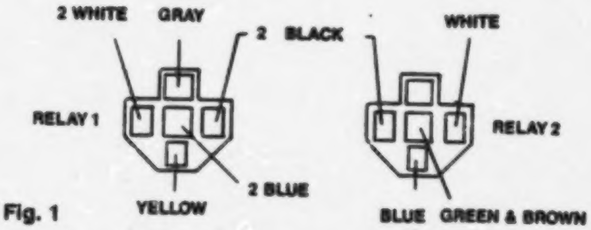


Fig. 1

   If wiring is wrong, see Trouble Shooting D. 2. to correct.

   d. There is usually an existing cable that feeds through a rubber grommet in the firewall.
      1. From engine side of firewall, use screwdriver to remove grommet.
      2. From passenger compartment, feed RED and BROWN wires through hole into engine compartment.
      3. Cut grommet from outside to wires at center.

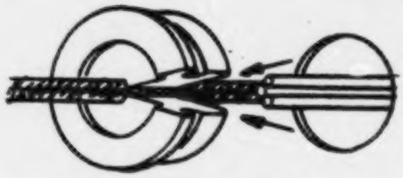


FIG. 2

4. Spread grommet apart and insert wire bundle.
5. Push grommet back into the firewall.

e. If hole must be drilled in firewall, insert grommet supplied (3/8" hole required) into hole to prevent wires from scraping against metal.

3. Select circulator and thermostat location according to these criteria:
   a. Circulator may be installed in either heater hose. Stepped ends of components fit 1/2", 5/8", and 3/4" I.D. heater hose.
   b. Thermostat must be installed in inlet hose to heater as close to engine as possible.
      To determine direction of coolant flow:
      ...Usually, flow is from engine thermostat to heater to engine water pump.
      ...LARGER heater house is OUTLET from heater to engine block.
      ...With engine running and heater on high, hotter heater hose is heater inlet.
   c. Both components must be: .
      ...AWAY FROM EXHAUST MANIFOLD
      ...Positioned to avoid vibration against other parts.
      ...Out of the way of dip sticks, filters and other routine service items.
   d. Circulator must be below coolant level of cooling system. Pump is not self-priming.
4. Install circulator in selected location.
   a. Clamp off heater hose on each side of selected location; or raise hose above coolant level while cutting to prevent coolant loss.

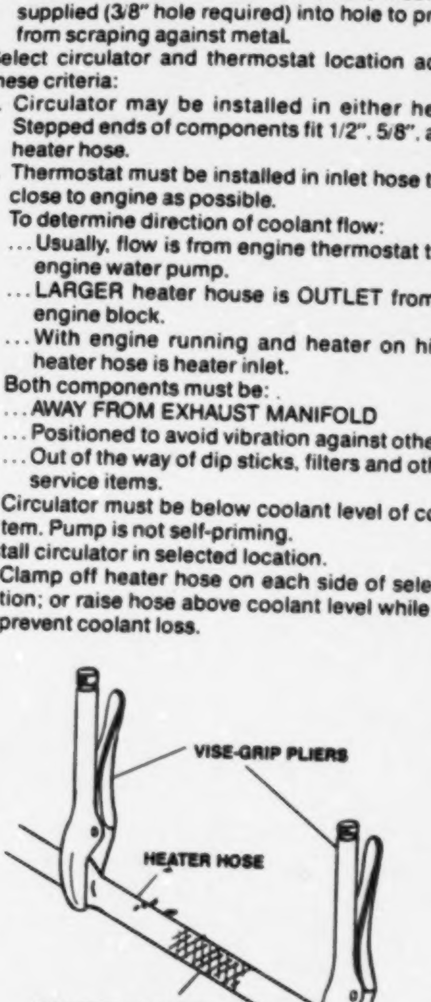

VISE-GRIP PLIERS
HEATER HOSE
SELECTED LOCATION

FIG. 3a

b. Cut hose with sharp knife.

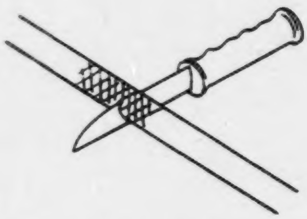


FIG. 3b

c. If necessary, cut off just enough hose to make room for circulator after determining which steps of circulator fitting fit existing heater hose.

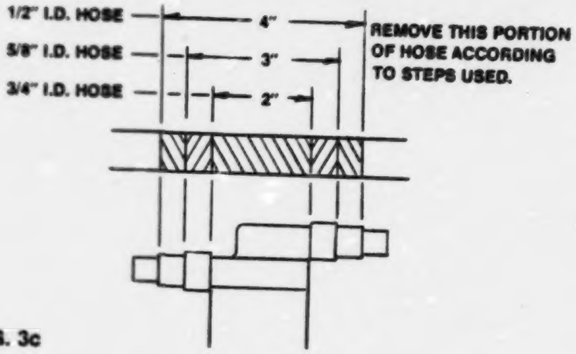

1/2" I.D. HOSE
4"
5/8" I.D. HOSE
3"
3/4" I.D. HOSE
2"
REMOVE THIS PORTION OF HOSE ACCORDING TO STEPS USED.

FIG. 3c

d. Slip a hose clamp over each end of cut hose.

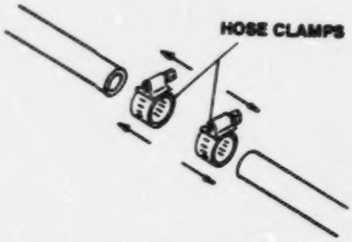
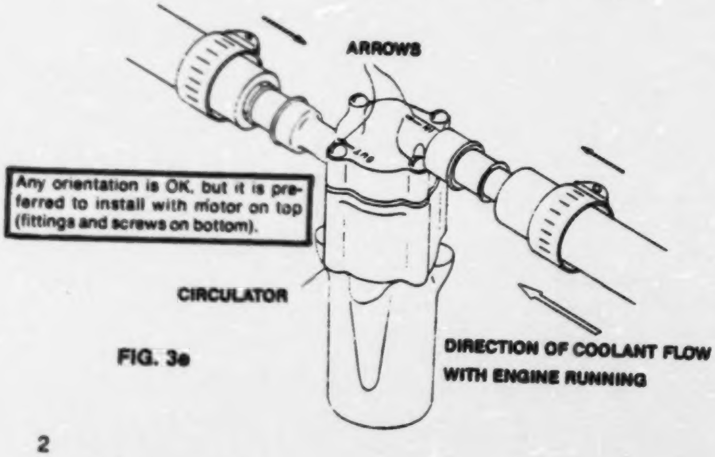

HOSE CLAMPS

FIG. 3d

e. Install circulator in hose so arrows on circulator point in direction of coolant flow with engine running.

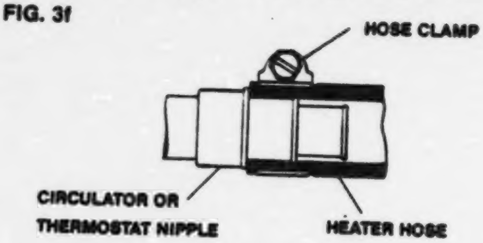

ARROWS
CIRCULATOR
DIRECTION OF COOLANT FLOW WITH ENGINE RUNNING

Any orientation is OK, but it is preferred to install with motor on top (fittings and screws on bottom).

FIG. 3e

f. Bring hose clamps over heater hose and circulator nipples. Tighten clamps until they bite into hose while holding circulator in position away from other components — especially **EXHAUST MANIFOLD.**

FIG. 3f



5. Install thermostat in selected location. Follow same procedure as for installing circulator.

REFER TO PICTORIAL 1 — UNDER HOOD WIRING

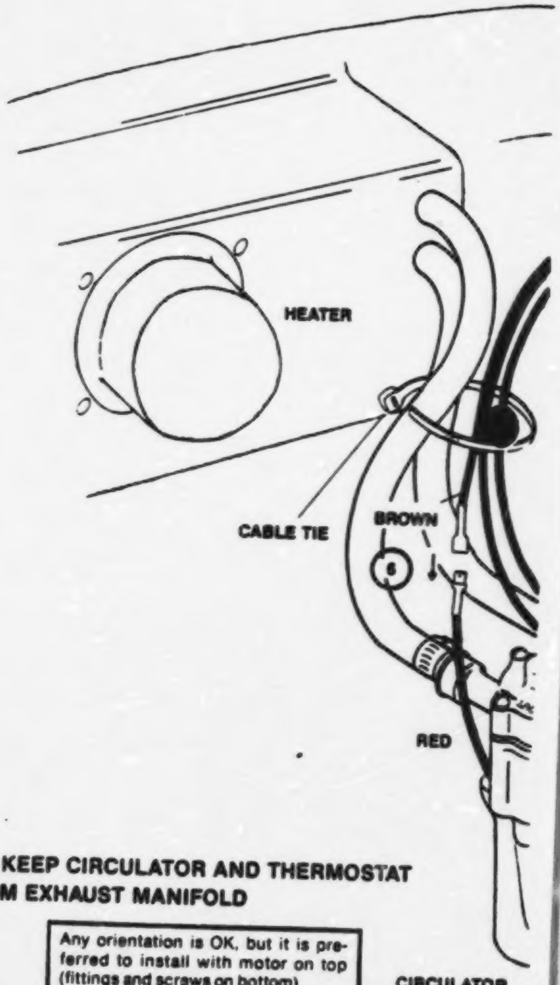
6. Connect BROWN wire from bundle #2 of harness to CIRCULATOR RED WIRE.
7. Connect RED wire from bundle #2 to either terminal of THERMOSTAT.

*8. Get loose RED wire with FUSEHOLDER. Connect short end (no terminal) to BATTERY DIRECT SOURCE. To locate battery direct source;
   a. Choose most convenient point which supplies 11.5 to 14.5 volts with the IGNITION OFF. Circuit will carry current for fan motor (usually less than 10A at lower speeds) and AUTOTHERM circulator and pilot light (less than 1A total).
   b. Typical pick-up points:
      1. Battery positive (+) terminal.
      2. Starter.
      3. Alternator/voltage regulator.
   c. Use voltmeter or test lamp to check for correct point.
   d. Use loose ring terminal or one of tap splice connectors supplied for the connection.

*9. Connect TERMINAL END of RED FUSEHOLDER WIRE to other terminal of THERMOSTAT. **CAUTION: DO NOT BEND THERMOSTAT TERMINALS.**

*If your system is supplied with a circuit breaker, there will be two (2) loose RED wires with 1/4" QC terminals instead of one loose wire with a fuseholder in it.
   a. Mount circuit breaker close to battery direct source on inner fender under hood with self tapping screws supplied (requires 9/64" — .140" — hole).
   b. Plug terminal of short RED wire onto circuit breaker terminal marked "BAT."
   c. Connect other end of short RED wire to battery direct source.
   d. Plug one terminal of long RED wire to other terminal of circuit breaker marked "AUX."
   e. Plug other terminal of long RED wire to open terminal of thermostat. **CAUTION: DO NOT BEND THERMOSTAT TERMINALS.**

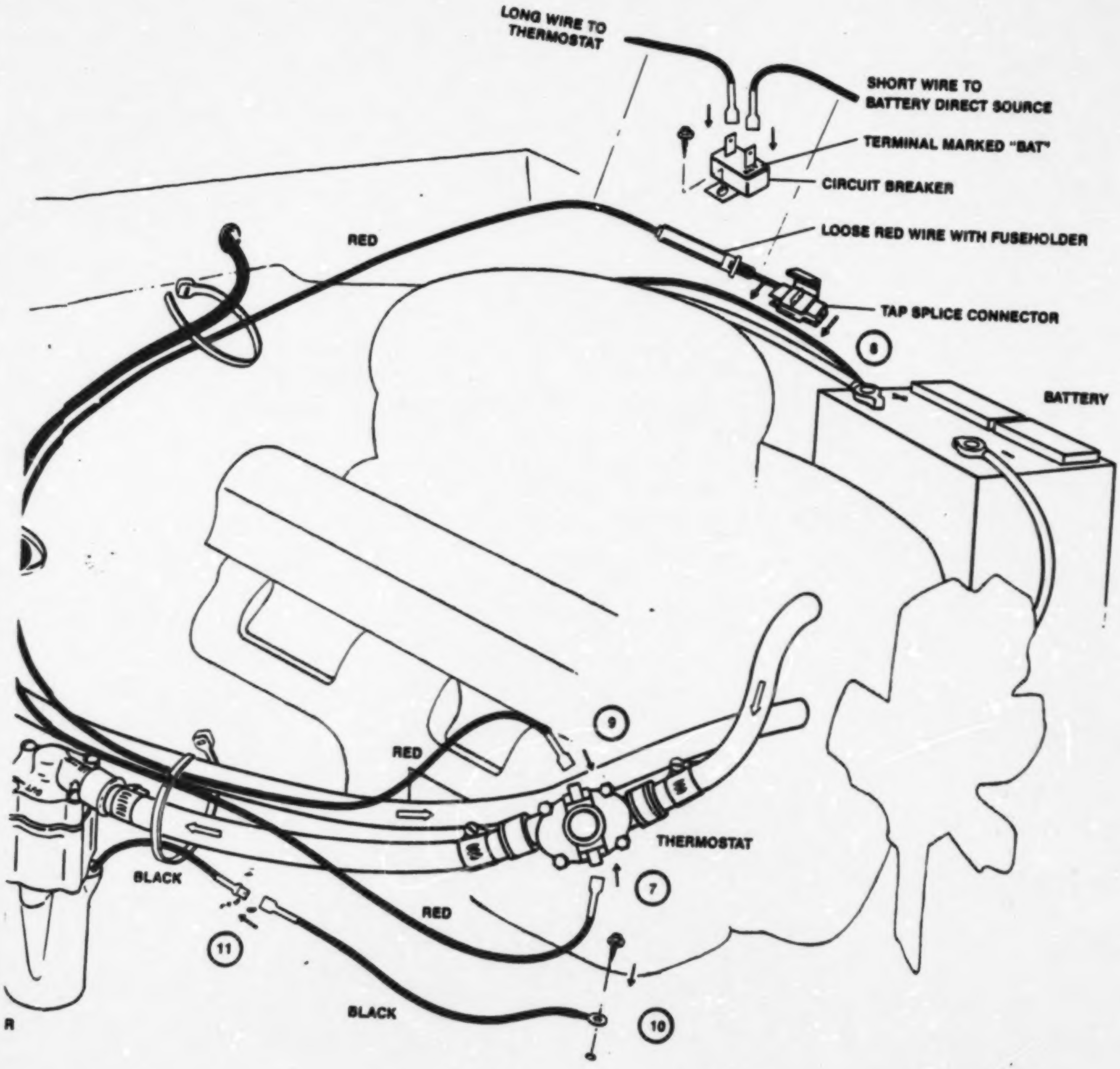
10. Connect ring terminal end of loose BLACK wire to vehicle ground. Use an existing screw or self tapping screw supplied (requires 9/64" — .140" — hole).
11. Connect other end of loose BLACK wire to CIRCULATOR BLACK WIRE.



CAUTION: KEEP CIRCULATOR AND THERMOSTAT AWAY FROM EXHAUST MANIFOLD

Any orientation is OK, but it is preferred to install with motor on top (fittings and screws on bottom).

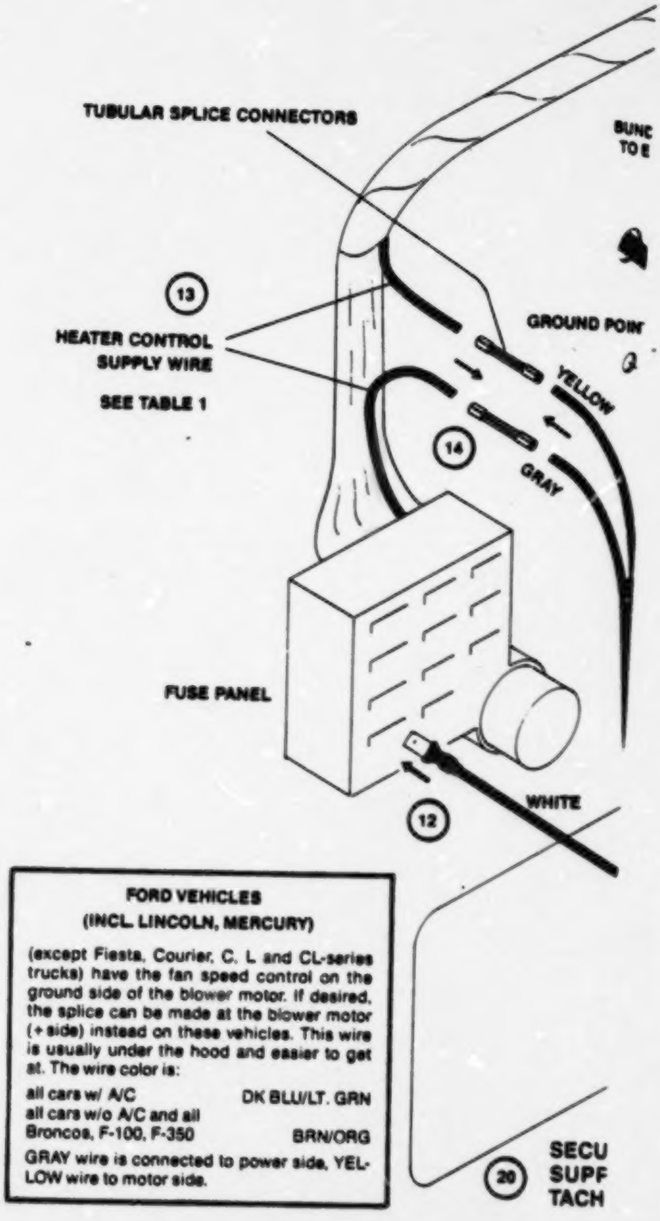
PICTORIAL 1 — UNDER HOOD WIRING


LONG WIRE TO THERMOSTAT
SHORT WIRE TO BATTERY DIRECT SOURCE
TERMINAL MARKED "BAT"
CIRCUIT BREAKER
RED
LOOSE RED WIRE WITH FUSEHOLDER
TAP SPLICE CONNECTOR
8
BATTERY
9
RED
THERMOSTAT
BLACK
7
RED
11
BLACK
10
R

⑳ **SECURE ALL WIRING OUT OF THE WAY WITH CABLE TIE SUPPLIED. ROLL EXCESS WIRE INTO LOOPS AND ATTACH TO EXISTING CABLES OR HOSES.**

REFER TO PICTORIAL 2 — UNDER DASH INSTALLATION

12. Connect WHITE wire to IGNITION ON SOURCE. To locate ignition on source:
    a. Choose most convenient point which supplies 11.5 to 14.5 volts only with the IGNITION ON. Circuit will carry current for the two (2) AUTOTHERM relay coils only (less than 0.5 A.).
    b. Suggested pick-up point:
    Fuse block "IGN" terminal or other terminal which supplies power only with the ignition on. DO NOT use terminal marked "ACC" as this will not allow use of AUTOTHERM system with key in "ACC" position.
    c. Use voltmeter or test lamp to check for correct point and to see if source turns on and off with turn of ignition key.
    NOTICE: AUTOTHERM system will run in "ACC" as well as "OFF" key positions if point where WHITE wire is connected does NOT have power with key in these positons. Use voltmeter or test lamp to check.
    d. Use terminal supplied on wire or one of the tap splice connectors supplied for connection.
13. Locate heater control supply wire.
    a. Choose the most convenient point to break the circuit that supplies power to the fan motor. Circuit must be broken on HOT side of fan speed switch — NOT at the fan motor (but OK on most Fords). There should be no loads other than the fan in the circuit.
    b. Suggested break point:
    Wire leading from fuse panel to heater control unit. Table 1 gives probable color of this wire for various vehicles. See note at right for Fords.
    c. Test for proper wire:
        1. Push probe of test lamp or voltmeter through insulation to conductor of selected wire.
        2. Turn ignition key on.
        3. The wire should have voltage.
        4. Remove the heater (A/C) fuse.
        5. The wire should NOT have voltage.
        6. Turn ignition off.
    d. If your vehicle is not listed and no wiring diagram for vehicle is available.
        1. Gain access to heater control unit.
        2. Unplug the function selector switch (Heat, A/C, Vent, Def. etc.) or fan speed switch if there is no function switch.
        3. With the ignition key on, carefully use a voltmeter or test lamp to find which wire in plug has power. This is the desired wire. Note color and turn key off.
        4. If more than one wire into plug has power and the wires are different colors:
            a. Pull out Heater fuse.
            b. Again check the voltage of the wires into the plug with ignition on.
            c. Replace fuse.
            d. The wire that had power with the fuse in, but did not with the fuse out, is the desired wire.
14. Connect YELLOW and GRAY wires to HEATER CONTROL SUPPLY WIRE:
    a. Cut wire found in 13 at convenient spot.
    b. Turn ignition key on and fan speed switch to each position. Fan should not run. Turn key and fan off.



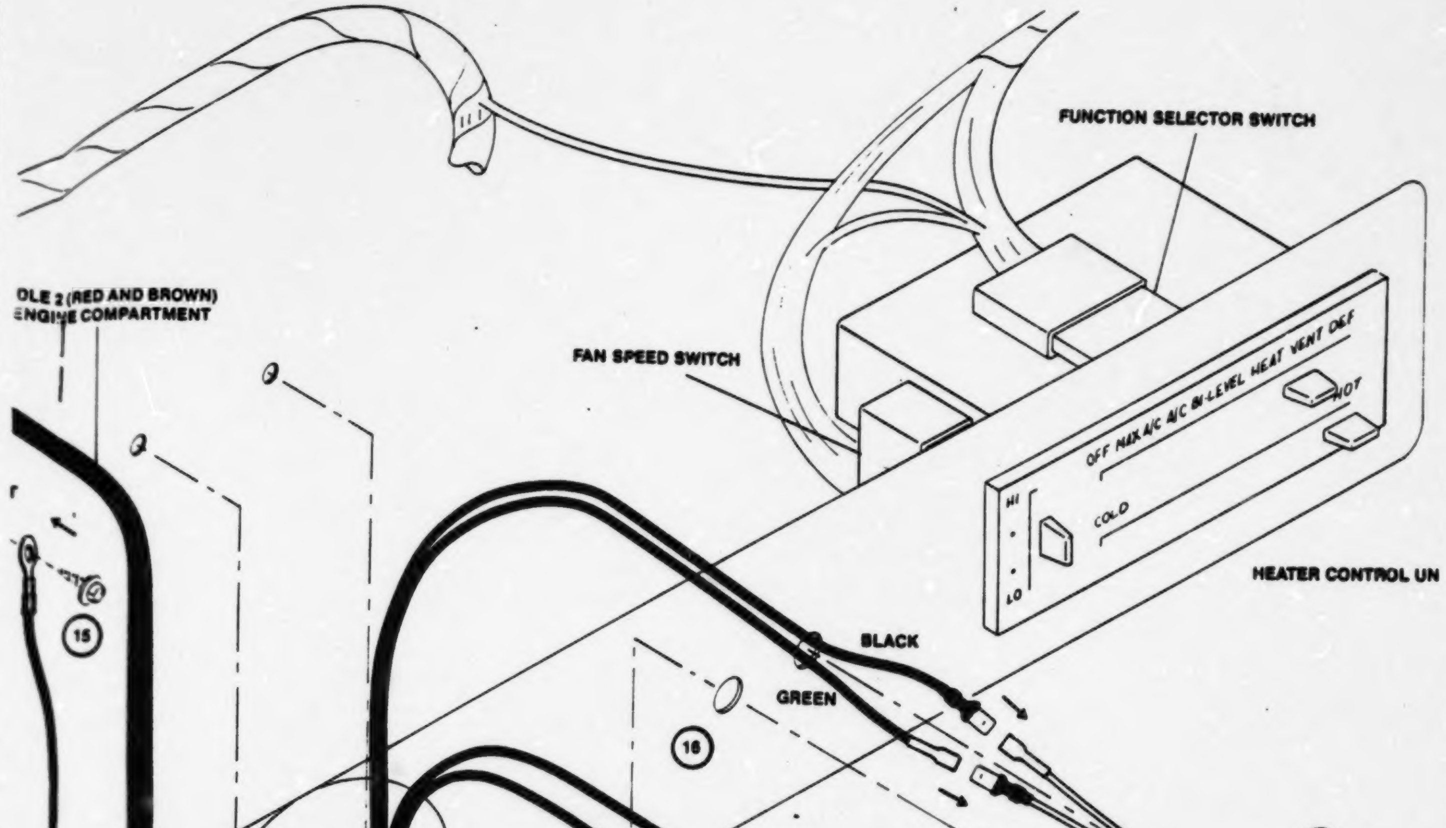
FORD VEHICLES
(INCL. LINCOLN, MERCURY)

(except Fiesta, Courier, C, L and CL-series trucks) have the fan speed control on the ground side of the blower motor. If desired, the splice can be made at the blower motor (+ side) instead on these vehicles. This wire is usually under the hood and easier to get at. The wire color is:

all cars w/ A/C	DK BLU/LT. GRN
all cars w/o A/C and all Broncos, F-100, F-350	BRN/ORG

GRAY wire is connected to power side, YELLOW wire to motor side.

PICTORIAL 2 — UNDER DASH INSTALLATIC


FUNCTION SELECTOR SWITCH
OLE 2 (RED AND BROWN)
ENGINE COMPARTMENT
FAN SPEED SWITCH
OFF MAX A/C A/C BI-LEVEL HEAT VENT DEF
HOT
COLD
HI
LO
HEATER CONTROL UN
15
BLACK
GREEN
16
BLACK
BLUE
RED
17
20
PILOT LIGHT
RELAYS
BUNDLE 1
BEZEL NUT
20
18
ON-OFF SWITCH
MAIN WIRE HARNESS

ALL WIRING OUT OF THE WAY WITH CABLE TIES
D. ROLL EXCESS WIRE INTO LOOPS AND AT-
EXISTING CABLES.

TABLE 1

MAKE-MODEL	WIRE GAUGE	WIRE COLOR
AMC/JEEP		
Pacer, Spirit, AMX, Concord, Eagle	14	Dk. Blue
Jeep CJ, Cherokee, Wagoneer, Truck	14 or 16	Red
CHRYSLER		
Cars without Air Cond.	16	Brown
Cars with Air Cond.	10[1]	Brown
[1]On Cordoba, Mirade, and Imperial: A 12 gauge BROWN leads from fuse block into harness. The 10 gauge BROWN is spliced in in the middle of this harness and leads to Heater-A/C control.		
Vans and trucks — 150, 250, 350 series, Ramcharger	14	Brown
FORD — See note on Pictorial 2 —		
Fiesta	—	Black/Red*
Courier	—	Lt. Blue
Econoline	10	Orange
All other FoMoCo cars and light duty trucks	10-14	Brn./Org.
C and L series trucks	—	Brown
GM		
All GM cars [2](including El Camino)	14 or 16	Brown
[2]Blower control is limited on cars with automatic temperature control.		
Light duty trucks (vans, pickups, Blazers and motor homes)	14	Brown

*Black/Red means Black wire with Red tracer stripe.

NOTICE This information obtained from manufacturers' service manuals for 1980 and 1982 vehicles. While manufacturers usually maintain their color coding from year to year, it is always advisable to consult the service manual for your particular vehicle when available.

c. Cut GRAY and YELLOW wires to length as required.
d. Strip each end of cut wire 1/4".
e. Connect GRAY wire to fuse block (HOT) side of cut heater supply wire with tubular splice connector supplied.
f. Connect YELLOW wire to heater control side of cut heater supply wire.
g. Tug gently on wires to test connections.

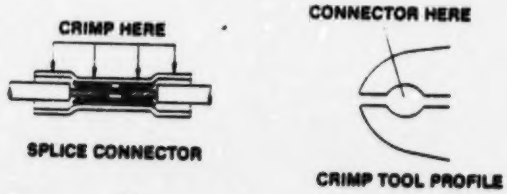


FIG. 4

15. Connect BLACK wire with ring terminal to metal under dashboard (ground).
    a. Scrape away any paint.
    b. Use existing screw or self tapping screw supplied (drill 9/64" hole).
16. Make hole (s) for switch and pilot light in convenient location on or under dashboard.
    a. Consider these factors when selecting a location:
        1. Switch accessible by driver, but won't interfere with knees or operation of other controls.
        2. Pilot light visible by driver, but not blinding him at night.
        3. Adequate space behind panel.
    b. Required hole sizes:

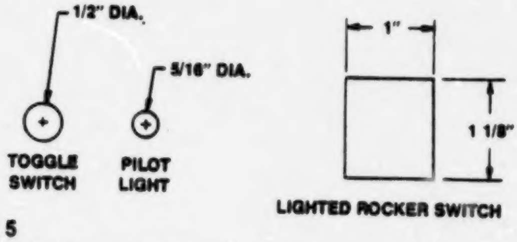


FIG. 5

    c. Carefully drill holes. Rectangular hole requires extra cutting and filing. Remove burrs from holes.
17. Connect wires from bundle #1 (4 wires in bundle) to switch and pilot light.
    a. From behind dash, feed BLACK and GREEN wires through hole made for pilot light.
    b. If lighted rocker switch is used, also feed BLUE and RED wires through the hole.
    c. Separate toggle switch and pilot light:
        1. Connect BLACK and GREEN wires to pilot light.
        2. Connect BLUE and RED wires to switch. It doesn't matter which wire goes to which terminal.
    d. Lighted rocker switch:

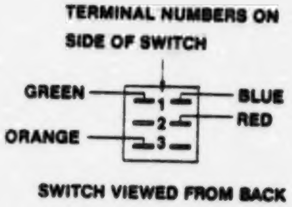


FIG. 6

    e. DO NOT install switch and pilot light to dash at this time.
18. Connect relays.
    a. Plug relays into connectors of wire harness.
    b. Fasten relays under dash with self tapping screws supplied (9/64" holes required) or use cable ties to attach to existing cables.
19. Test operation before mounting switch and pilot light to dash or dressing wiring.
    a. Be sure circulator has water in it (no air lock).
        1. Remove radiator cap.
        CAUTION: Engine must be cold to do this.

2. Make sure heater hoses and circulator are below coolant level.
3. Any air will then rise to the surface and circulator will have coolant in it.
4. Check coolant level — top off if necessary.
5. Replace radiator cap.

b. Start engine and let it warm up so engine thermostat opens.

c. While engine is warming up:
   1. Check for coolant leaks.
   2. Turn AUTOTHERM switch on and off. Pilot light should NOT come on while engine is running.
   3. Check for correct heater fan speed at all fan switch positions.
   4. Turn heater on and check for heat.

d. When warm air is coming from heater, turn engine off.

e. Turn AUTOTHERM switch on.
   1. Pilot light should light.
   2. Heat should continue to flow from heater.
   3. Heater controls should function normally. Check for correct fan speed at all fan switch positions.

CAUTION: Never let a vehicle go into service with fan running at high speed only. This wears down the battery and will cause restarting problems.

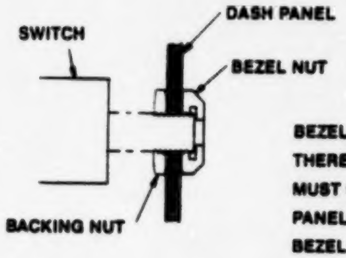
NOTICE: On some vehicles (especially GM), the air conditioner is activated when the controls are set to the "DEFROST" mode. The extra current draw of the compressor clutch solenoid with the AUTOTHERM system in use can exhaust the battery. If the test light shows power to the solenoid under these conditions, warn the user not to use the AUTOTHERM in Defrost. (Once the vehicle interior is warm, the Defrost setting is usually not necessary anyway.) The alternative solution is to install the Clutch Solenoid Cut-out Relay Kit, P.N. 1032, available at nominal cost from the factory.

NOTICE: On systems supplied with the automatic reset circuit breaker instead of a fuse, the fan and pilot light may cycle on and off at high fan speeds. This is an intended feature of the circuit breaker which is meant to prevent the use of high fan speeds while using the AUTOTHERM system, and thus limit current drain from the vehicle battery.

4. If you are not sure the AUTOTHERM system is supplying the heat, disconnect the circulator by unplugging the BLACK wire at the circulator. Heater should begin blowing cooler air in a few minutes. Reconnect circulator and note warmer air coming from heater.

f. Any problems — see Trouble Shooting Section.

20. Complete installation.
   a. Push pilot light (or lighted rocker switch) into dash from front.
   b. Install toggle switch from behind dash.



BEZEL NUT HAS STOP. THEREFORE, BACKING NUT MUST BE BROUGHT UP TO PANEL BEFORE TIGHTENING BEZEL NUT.

FIG. 7 SWITCH MOUNTING

c. Secure all wiring out of the way with cable ties supplied.

d. Clean inside of driver's side window and place AUTOTHERM identification decal in lower corner just above lock button.

e. User Instruction decal or card should be attached to visor or otherwise displayed to user. It is also good practice to keep this manual with the vehicle's owner's manual in the glove box for future reference. ☐

WIRE CONNECTION SUMMARY CHART

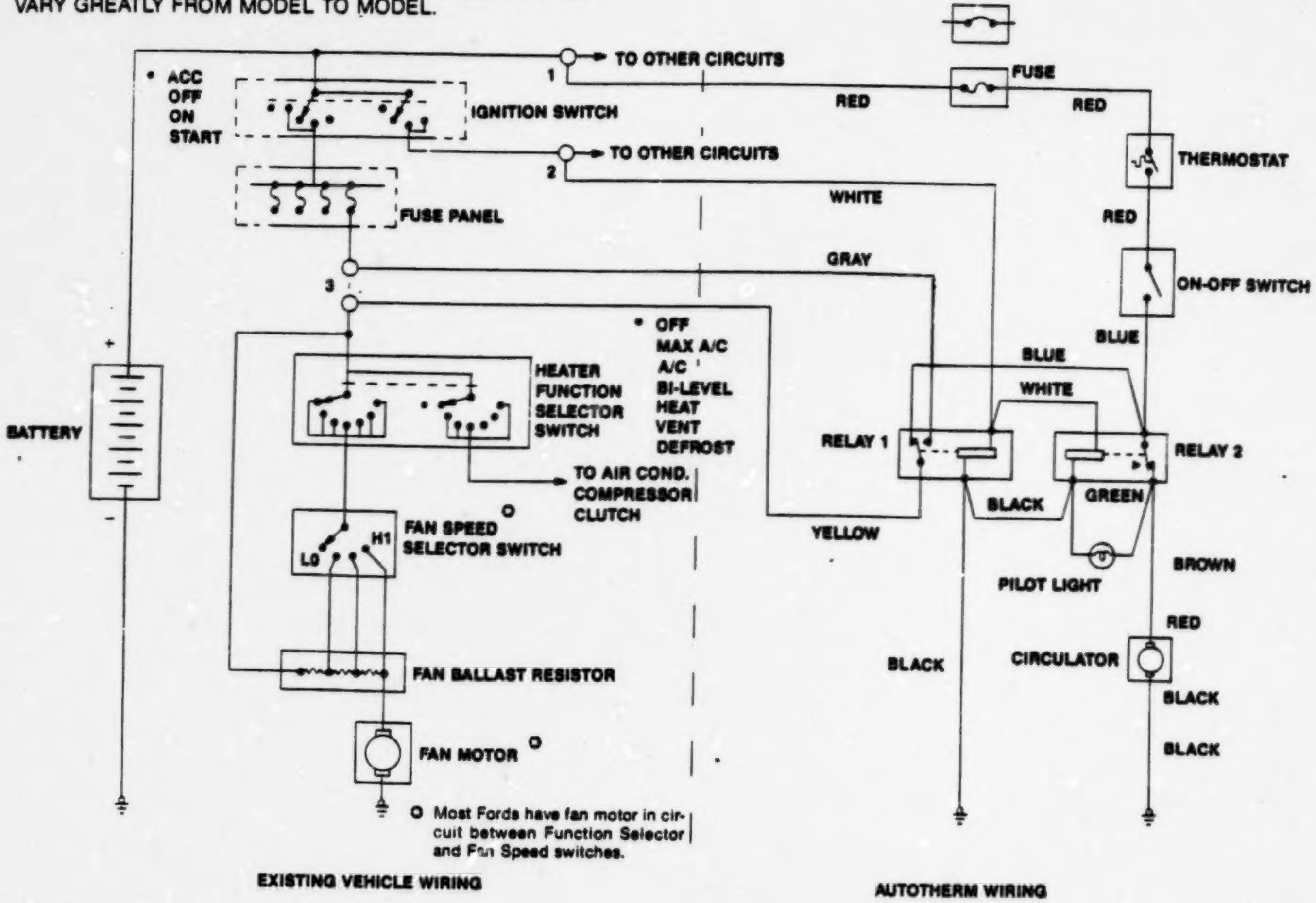
COLOR	FROM	TO
	MAIN WIRE HARNESS	
Black	Relay	Ground
Gray	Relay	Fan Supply Wire-Power Side
Yellow	Relay	Fan Supply Wire-Fan Side
White	Relay	Ignition On Source
Red	—	Thermostat
Brown	Relay	Circulator-Red Wire
Green	Relay	Pilot Light
Black	Relay	Pilot Light
Blue	Relay	On-Off Switch
Red	—	On-Off Switch
	LOOSE RED WIRE WITH FUSEHOLDER	
Red	Battery Direct Source	Thermostat
	LOOSE BLACK WIRE	
Black	Ground	Circulator-Black Wire

IV TROUBLE SHOOTING

TROUBLE SHOOTING CHART

ENGINE	AUTOTHERM SWITCH	PROBLEM	POSSIBLE CAUSE	REMEDY
1. On	On	Pilot light on	a. No voltage at ignition on source b. Relay plug wired incorrectly c. Defective relay 2	See Instr. 12 See Instr. 2.c. See Below A.1 & 3
2. On	Off or On	Relays buzz	a. Low voltage at ignition on source Usually white wire to wrong terminal of ignition coil. b. Bad diode in alternator	See Instr. 12 Have shop check alternator
3. On	Off or On	Fan doesn't run	a. Bad connections especially splice of YELLOW and GRAY wires. b. Relay plug wired incorrectly	See Instr. 15 See Instr. 2.c.
4. On	See Right	Fan runs only with AUTOTHERM switch on	a. No voltage at ignition on source b. Relay plug wired incorrectly c. Defective relay 1	See Instr. 12 See Instr. 2.c. See Below A.1 & 3
5. Off	On	Pilot light off, no heat.	a. In-line AUTOTHERM fuse blown b. Defective thermostat c. Relay plug wired incorrectly d. WHITE wire has voltage with ignition off e. Bad connections f. Incorrect thermostat location	Check fuse. See Below B.1 See Instr. 2.c. See Instr. 12 Check. See Instr. 3.b.
6. Off	On	Fan runs, pilot light on, but no heat after couple minutes	If circulator is not running: a. Bad connections at circulator b. Defective circulator If circulator is running: a. Circulator wires reversed b. Air lock in heater hose	 Check See Below C. See Instr. 6 & 11 See Instr. 19. a
7. Off	On	Pilot light on, no fan	a. YELLOW and GRAY wires reversed b. YELLOW and GRAY wires spliced into wrong wire. c. Relay wired incorrectly d. Defective relay 1 e. Heater function selector on "Off."	See Instr. 14 See Instr. 13 See Instr. 2.c. See Below A. 2 Check
8. Off	On	Fan runs on one speed only	a. YELLOW and GRAY wires spliced into wrong wire.	See Instr. 13
9. Off	On	Fan works in A/C mode only	a. YELLOW and GRAY wires spliced into wrong wire.	See Instr. 13
10. Off	On	Everything works fine but short heating time (longer than 10 minutes but shorter than expected)	a. Incorrect thermostat location b. Defective vehicle thermostat	See Instr. 3.b. See Below E
11. On	Off or On	Pilot light comes on at higher engine speeds	a. Circulator installed backwards (coolant flowing against arrows)	Reinstall — See Instr. 3 & 4
12. Off	On	System does not shut itself off.	a. Defective thermostat	See Below B.2
13. Off	On	Alternator light is on, AUTOTHERM works fine	a. Usually not a defect — be sure there is no power at the alternator field terminal.	None required
14. Off	On	Engine runs on after key turned off.	a. BLACK relay wire not grounded properly.	Check

WIRING DIAGRAM SHOWS WIRING FOR A TYPICAL VEHICLE (GM CAR WITH AIR CONDITIONING). CIRCUIT DETAILS VARY GREATLY FROM MODEL TO MODEL.



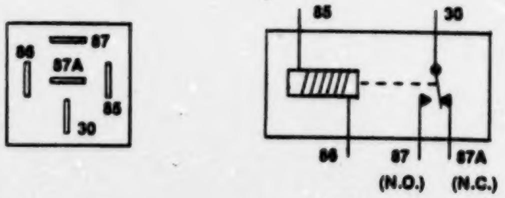
ACC
OFF
ON
START
IGNITION SWITCH
1
TO OTHER CIRCUITS
2
TO OTHER CIRCUITS
FUSE PANEL
3
FUSE
RED
RED
THERMOSTAT
WHITE
RED
GRAY
ON-OFF SWITCH
BLUE
BLUE
WHITE
OFF
MAX A/C
A/C
BI-LEVEL
HEAT
VENT
DEFROST
HEATER FUNCTION SELECTOR SWITCH
BATTERY
+
-
RELAY 1
RELAY 2
BLACK
GREEN
TO AIR COND. COMPRESSOR CLUTCH
YELLOW
FAN SPEED SELECTOR SWITCH
LO
HI
PILOT LIGHT
BROWN
RED
CIRCULATOR
BLACK
BLACK
BLACK
FAN BALLAST RESISTOR
FAN MOTOR
EXISTING VEHICLE WIRING
AUTOTHERM WIRING

O Most Fords have fan motor in circuit between Function Selector and Fan Speed switches.

WIRING DIAGRAM

1 BATTERY DIRECT SOURCE
2 IGNITION ON SOURCE
3 HEATER CONTROL SUPPLY WIRE

A. CHECK RELAYS:
Relay 1 — Has YELLOW and GRAY wires to it.
Relay 2 — Has GREEN and BROWN wires to it.



86
87
87A
85
30
85
30
86
87
87A
(N.O.)
(N.C.)

FIG. 8

Viewed from bottom (terminal end) of relay

1. Coil open:
   a. Unplug relay.
   b. Use ohmmeter or continuity tester to check continuity across terminals 85 and 86.
   c. Resistance should be about 85 Ω and continuity light should glow. If not, relay is defective.
2. N.C. (normally closed) contacts open:
   a. Unplug relay
   b. Check continuity across terminals 30 and 87 a.
   c. If no continuity, relay is defective.
3. N.O. (normally open) contacts don't close (relay 1 only):
   a. Leave relay plugged in and turn ignition key on.
   b. Insert probe of voltmeter or test lamp into relay plug from wire end to check for voltage at terminal 30 (YELLOW wire).

c. If no voltage, heater fuse is blown or YELLOW wire has bad connection.
d. If voltage at 30, check voltage at terminal 87 (GRAY wire).
e. If no voltage, relay is defective.

B. CHECK AUTOTHERM THERMOSTAT:

NOTE: Before suspecting defective thermostat, make sure engine was thoroughly warmed up. Also, heater control must call for heat so hot water flows through thermostat to actuate it. Also, make sure thermostat is installed in INLET hose to heater (see Instr. 3).

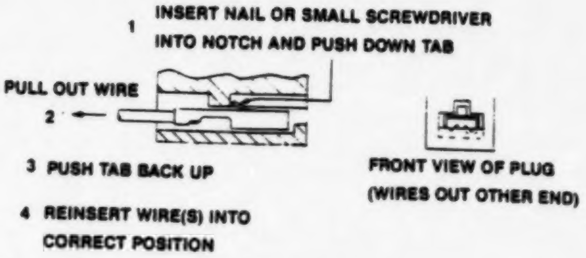
1. Check for permanently open contacts. (This could have been caused by bending thermostat terminals):
   a. Turn key off, AUTOTHERM on, fan to low or off.
   b. Under hood, remove two (2) RED wires from thermostat.
   c. Carefully touch them together and note if circulator runs.
   d. If circulator runs, thermostat is defective.
2. Check for permanently closed contacts:
   a. Make sure thermostat has cooled down below 85° F.
   b. Check continuity across thermostat terminals. If there is continuity, thermostat is defective.

C. CHECK CIRCULATOR

1. Check AUTOTHERM fuse.
2. Unplug BROWN wire from RED wire of circulator.
3. Unplug RED fuseholder wire (to battery) from thermostat. CAUTION: RED wire has power. DO NOT touch to ground.
4. Plug RED fuseholder wire to RED wire of circulator.
5. If circulator does not run, it is defective.

D. CHECK RELAY PLUG WIRING.

1. See instruction 2.c.
2. To correct wiring error in relay plug:


1 INSERT NAIL OR SMALL SCREWDRIVER INTO NOTCH AND PUSH DOWN TAB
PULL OUT WIRE
2
3 PUSH TAB BACK UP
4 REINSERT WIRE(S) INTO CORRECT POSITION
FRONT VIEW OF PLUG (WIRES OUT OTHER END)

E. CHECK ENGINE THERMOSTAT

1. Start car and warm engine to what should be normal operating temperature by driving 10-15 minutes.
   a. Vehicle water temperature gauge (if equipped) should be in normal range.
   b. Hose from engine thermostat to radiator should be too hot to hold. If not, thermostat hasn't opened and should be replaced.

FOR FACTORY ASSISTANCE CALL: (312) 381-6366

CERTIFICATE OF GUARANTEE

The AUTOTHERM Energy Conservation System is guaranteed as follows:

To be free of defects in workmanship and material (except fuses and light bulbs) for a period of twelve months as determined by date codes and/or serial numbers stamped on the product at the time of manufacture.

That for the life of the original installation, your AUTOTHERM Energy Conservation System circulator will never leak engine coolant.

Defective units or parts returned directly to the factory address on this certificate, properly packaged and prepaid, will be replaced or repaired, at the company's descretion, where examination by its engineers confirms defects and its determination shall be final. The guarantee does not cover failures or defects which in the company's opinion are caused by abuse, accident, improper use of or failure to follow use and installation instructions currently published. The extent of the liability of AUTOTHERM, Inc. shall for any reason be limited to twice the original purchase price of the AUTOTHERM Energy Conservation System circulator unit or part being returned for inspection and service. This document represents the only guarantee and no other guarantee is intended or implied. The company assumes no responsibility for damages due to interpretation of material in such instructions nor to errors or ommissions which they may contain from time to time. Employees, Representative Agents, or Dealers cannot extend or modify, verbally or in writing, the guarantee stated herein.

Workmanship and materials supplied by the installer or dealer are not part of the company's products or its replacement are guaranteed by the installer or dealer. AUTOTHERM, Inc. shall not be liable for, nor guarantees the labor, workmanship, or materials supplied by others.

There are no warranties, express or implied, made by the seller or supplier which extend beyond the description on the face hereof. All warranties herein stated are expressly in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose. Buyer's sole and exclusive remedy for breach of all warranties pertaining to the goods shall be the repair or replacement of any defective parts thereof due to faulty workmanship or construction.

AUTOTHERM, Inc.

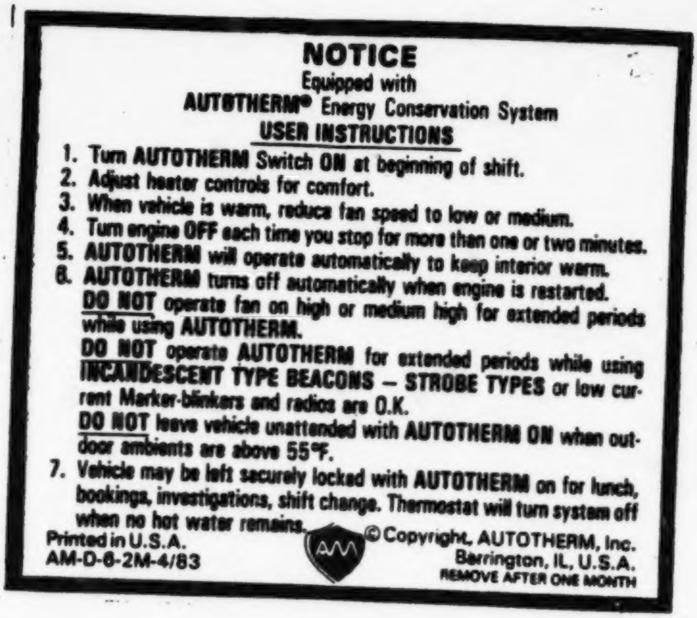
314 E. Main Street, Barrington, IL 60010

P/N 01078 11/82

© Copyright, 1982

AUTOTHERM, Inc.
314 E. Main St.
Barrington, IL 60010
Printed in U.S.A.

ATTACHMENT I



NOTICE

Equipped with
AUTOTHERM® Energy Conservation System

USER INSTRUCTIONS

1. Turn **AUTOTHERM** Switch **ON** at beginning of shift.
2. Adjust heater controls for comfort.
3. When vehicle is warm, reduce fan speed to low or medium.
4. Turn engine **OFF** each time you stop for more than one or two minutes.
5. **AUTOTHERM** will operate automatically to keep interior warm.
6. **AUTOTHERM** turns off automatically when engine is restarted.
   DO NOT operate fan on high or medium high for extended periods while using **AUTOTHERM.**
   DO NOT operate **AUTOTHERM** for extended periods while using **INCANDESCENT TYPE BEACONS – STROBE TYPES** or low current Marker-blinkers and radios are O.K.
   DO NOT leave vehicle unattended with **AUTOTHERM ON** when outdoor ambients are above 55°F.
7. Vehicle may be left securely locked with **AUTOTHERM** on for lunch, bookings, investigations, shift change. Thermostat will turn system off when no hot water remains.

Printed in U.S.A.
AM-D-6-2M-4/83

© Copyright, AUTOTHERM, Inc.

Barrington, IL, U.S.A.
REMOVE AFTER ONE MONTH

ATTACHMENT J

MMIRAB RECORD COPY

SEP 2[illegible] 1982

MMIRAB-1 (Mr. Cronin, 2676)

Recommendations Resulting From MEEP Project Number H81-16C, Autotherm Heater, Car Comfort System (AFR 77-5)

[redacted]

1. Project was conducted to ascertain if Model EVK-2100IT heaters, while employed on Air Force (AF) vehicles, would maintain vehicle interior warmth in cold weather and save on gasoline consumption. Common practice is for vehicle operators to leave engine running in cold weather to maintain adequate warmth when vehicle is stopped. Prolonged idling wastes fuel, causes plug fouling, and allows excessive exhaust emissions (which increases environmental pollution). Safety hazards related to carbon monoxide poisoning and vehicle runaway exist. Since Autotherm units operate with vehicle ignition off, determinations were made on effectiveness of heater, on whether utilization of same results in safer methods employed to obtain vehicle warmth, and whether fuel consumption is reduced.

2. Period of Evaluation: 15 Jan 82 to 15 Jun 82.

3. Evaluating Activities: SAC at Offutt, Loring and Peterson AFBs. ATC at Lowry, Chanute, and Columbus AFBs.

4. Application/Use: Peterson AFB installed units on three (3) Ford Fairmonts, Loring installed a unit on a Chevrolet and AMC sedan. Offutt installed a unit on a Plymouth and Ford Sedan. Lowry installed a unit on a Dodge D200 truck. No reporting was received from Chanute and Columbus AFBs installations. Vehicles were utilized by Security Police, Law Enforcement and ALERT response teams, vehicle operations base protocol and taxi operations, and minor maintenance activities. Generally vehicles were under 24 hour operation of stop and go driving.

5. Method of Evaluation: Kit installation required an average time of 3.0 man hours. Vehicles were tuned with diagnostic equipment, checked out on dynomometers, and electrical/charging systems determined in good condition. Nominal amperage drawn under normal operation of comfort system was 5.0 amps. Vehicle interior temperature and outside ambient was monitored. Baseline fuel consumption was established for six cylinder vehicles. Six cylinder vehicle consumption is .076 gallons/hour at engine idle. Effectiveness of Autotherm heater was determined by comparing vehicle interior heat maintained to a comfortable warmth, with interior heat of vehicles not so equipped.

6. Results of Evaluation: Comfortable vehicle interior warmth was maintained as follows:

Time in minutes	Outside ambient
40	12°F Snowing/no wind
35	12°F Snowing/no wind
31	28°F Slight wind
45	37°F No appreciable wind

Potential safety hazards related to carbon monoxide poisoning and vehicle runaway are considerably reduced when employing Autotherm units. No maintenance problems with the car comfort system were reported. Gallons of gasoline saved varied from 0.76 gallons/hour to 2.3 gallons/hour for six cylinder vehicles. Cost analysis provided showed bases with a winter season of mean temperatures below 40°F, employing car comfort systems in 10 vehicles will realize savings of approximately $2600 and 2000 gallons of gasoline over the winter season. Tangible savings of over $1000 per vehicle equipped with Autotherm units during 5 year unit life expectancy is probable. AF wide savings for 100 bases with 10 vehicles/base equipped with these units would approximate $1,000,000 over a 5 year period.

7. Recommendations:

a. Since GSA has included item in GSA catalog under NSN 2930-01-130-3218, recommend AF be included as user.

b. Upon completion of cataloging action TA manager to include item into TA-457. BOI as required for bases exhibiting mean ambients below 45°F during cold season.

c. WR-AL[redacted] to include item into T.O. 36-1-50, Chapter III.

8. Your reply as to action taken to complete cataloging will be appreciated by 1 Oct 82.

[redacted]

Ch, Engineering & Reliability Br
Item Management Division DMM

Cy to: [redacted]

UNIT IS AVAIL THRU REGIONAL GSA VIA MIL STRIP REQUISITIONING PROCEDURES
@ $150/KIT.

PROJECT COMPLETION REPORT

No. HP 81-16

STRATEGIC AIR COMMAND

Management/ Equipment Evaluation Program

PETERSON AFB, CO.

Atch 1^{2}

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

REPLY TO
ATTN OF:

12 August 1982

SUBJECT: Phase I Completion Report, Project HP 81-16C, AFR 77-5

TO:

1. Project Title: Autotherm Heater

2. Date Started: 11 January 1982

3. Date Completed: 15 June 1982

4. Description.

a. This project was established to test and evaluate a Model EVK 2100 iT Autotherm Energy Conservation System. The system consists of 5 items depicted in Figure 1 and hardware for installation. The system is designed to continue circulating heated water through the vehicle heater after the ignition switch is turned off. This allows occupants of the vehicle to stay in a warm interior for a period of time without idling the engine. The Model EVK 2100 iT costs approximately $132.00 in kit form and is easy to install following the installation instructions provided.

b. The requirements for conducting the evaluation were to determine economics, maintenance problems, advantages/disadvantages of installing this type unit on vehicles requiring prolonged idling to maintain a heated interior for personnel occupying the vehicles for periods of time without engine running. Examples of these are: Security Police, flightline, base taxi, supply delivery, etc.

c. The Autotherm unit is manufactured by Autotherm Sales Corporation, 314 East Main St, Barrington IL 60010, phone (312) 381-6366.

5. Discussion.

a. The initial paperwork and project directive were received in December 1981. Acknowledgement was submitted in January 1982. The Autotherm representative, Mr Len Dunlop, from Chicago IL, phone (313) 792-1460, called on 4 January 1982. His conversation consisted of:

(1) No manufacturer's representative would visit Peterson AFB for installing equipment.

(2) Owners guide and installation procedures were mailed separate from the three kits.

Page 2, of Phase I Completion Report Memo from Peterson AFB was not included in material furnished to EPA.

The nominal draw during normal operation of the Autotherm for the three vehicles was 5.5 amps. This is not a problem for most vehicles except the Security Police. If they have all their lights on and the engine off for any length of time the battery drains very fast. This situation would be very rare as Security Police personnel are normally cognizant of this problem and would not allow it to happen.

g. Several tests were conducted measuring duration of Autotherm operation. Temperature measurements taken inside the vehicle were obtained using an air conditioning thermometer. The vehicles were positioned outdoors away from buildings. The engine was operated until inside temperature stabilized at 82°F. The outside temperature was 28°F with a slight wind. The ignition switch was turned off and the Autotherm automatically came on. The stop watch was started at this point in time and was stopped when the Autotherm unit cut off. The time span for this duration was 31 minutes and the inside temperature was at 72°F. The 72°F temperature was very comfortable for occupants of the vehicle.

h. The next test conducted was in the same area with no wind and temperature at 37°F outside. The engine was again operated until inside temperature stabilized at 80°F inside. The ignition switch turned off, stop watch started when Autotherm started. This time the Autotherm operated for 45 minutes before the unit shut off. The inside temperature was 65°F and still comfortable for the occupants.

i. Engine idle tests were conducted on test vehicles as well as several other vehicles using the FloScan gas meter. This measurement of fuel at idle for a period of one hour would establish a baseline for computing the economics of the Autotherm unit. Every vehicle engine at idle will vary slightly as to fuel consumed depending on altitude, humidity and engine condition. Therefore, an average must be determined for computation purposes and not solely for a particular vehicle. Vehicles in the sedan configuration are being purchased with primarily 6 cylinder engines and 4 cylinder engines. The baseline should be established for those engine sizes.

Reg No	Vehicle	Engine Size	1 Hr/Gal Consumption
80B2671	Fairmont	6 cyl	.9
79B5656	Fairmont	6 cyl	.7
80B2671	Fairmont	6 cyl	.8
80B1830	Dodge	6 cyl 225 cu in	.7
80B1831	Dodge	6 cyl 225 cu in	.7

j. The baseline for 6 cylinder engine vehicles is .76 gallons per hour at idle. This figure will be used in determining cost effectiveness of the Autotherm unit at this activity. Other MEEP activities having 4 cylinder engine application should have a similar format for the economic operation.

k. The users were contacted for their comments on the use of the installed Autotherm unit. In all cases the operators were very impressed with the comfort provided by the unit without engine running. The taxi driver on the day shift was very impressed with the unit since he would sometimes park awaiting dispatch. With the unit operating during these times his vehicle was always comfortably warm. The same comments were noted by Security Police operators during the daytime and also night operations.

l. During the test phase no maintenance problems were noted on any of the units. It is doubtful if any major maintenance problems will be apparent for approximately five years. This would be dependent on heater hose life, plastic pump components and solenoid housing. If installation instructions as to placement of these components are followed the life expectancy would be five years. However, Security Police vehicles are set up for a three year turn around now so this could present a problem for them.

m. The safety aspects of using the Autotherm unit in lieu of engine idling for periods of time will surely deter possible carbon monoxide poisoning. The best safety aspect is maintaining a warm vehicle while not leaving a vehicle engine idling and vehicle unattended. Although this is against AF policy, it still happens on inclement days.

n. The advantage to the engine by having an Autotherm installed is the extended life of spark plugs from no engine idling during long periods of time during cold winter days and nights.

o. To determine full amortization of the Autotherm, the total cost is divided by the cost per gallon of fuel to equate gallonage that must be saved thru use of Autotherm. This factor is then divided by average gallons per hour at idle to determine total hours of operation of Autotherm required for amortization. The hour meters provided with the Autotherm kit and the fuel FloScan Model 660 aided in data used for the following computation.

p. Cost Analysis:

(1)	Equipment Cost/Vehicle		$132.00
(2)	Installation Cost 2.5 M/Hrs @ $20.00/Hr/Vehicle		50.00
(3)	Total Cost/Vehicle		182.00
(4)	Fuel Cost/Gallon		1.29
(5)	Average Gal/Hr at Idle (para 5j)		.76
(6)	$182.00 ÷ 1.29 =	141 gallons	
(7)	141 ÷ .76 =	185.5 hours	

q. The cost analysis formula denotes that 185.5 hours of Autotherm operation will amortize the total cost of the unit. The hours of operation for the Autotherm is predicated on vehicle missions (i.e., 8, 16, 24 hour operation), severity of cold weather and operator integrity to use the unit. With these items in mind, most units could be amortized within one winter season based on usage at Peterson AFB for only four months data.

r. A base with 300 vehicle population would have approximately 10-12 vehicles that would have a need for the Autotherm. An average cold winter would probably accumulate 200 hours minimum per vehicle for a 16-24 hour vehicle operation. At .76 gallons per hour baseline for 6 cylinder engines, an annual cost saving would be $1,960.80 based on $1.29 per gallon for fuel.

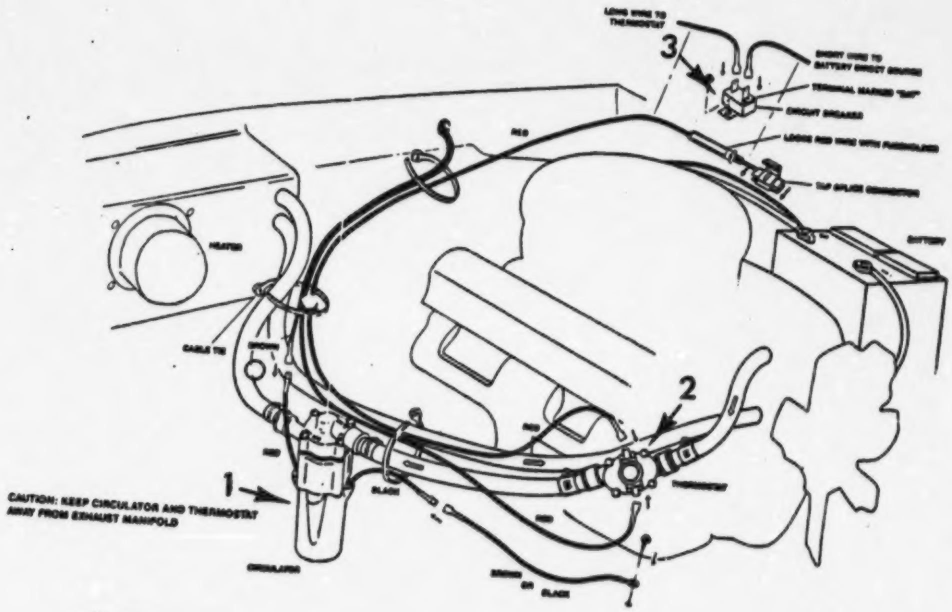
(1) 10 vehicles X 200 = 2,000 hours

(2) 2,000 X .76 = 1,520 gallons

(3) 1,520 gallons X $1.29 = $1,960.80 cost savings per annum per base

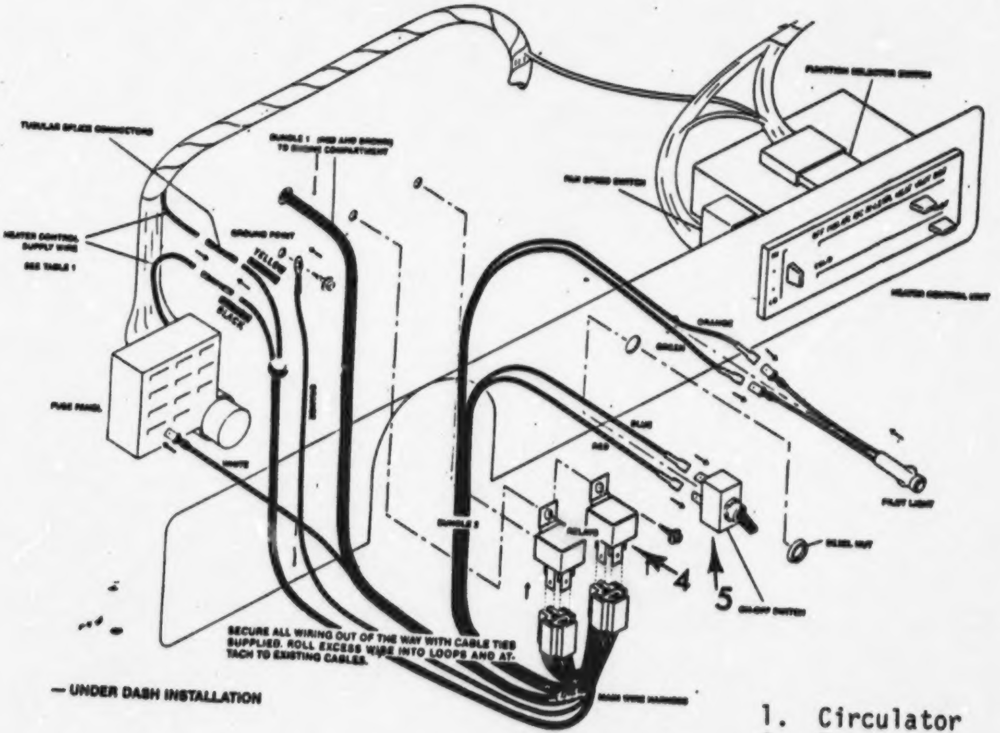
(4) Not only is a cost saving realized but a fuel savings is in the offing as well. Since the vehicle engine is not operated, 1,520 gallons of fuel is saved. This is conservatively based on vehicle being operated from 8 hours - 24 hours with only two to three engine shutdowns for a period of 30-45 minutes duration per shutdown.

s. The mean temperature below 40°F in the Colorado Springs area is used for comparison on total days the Autotherm would be used. The chart reflects January, February, March, November and December are months below the 40°F mean. This represents 151 days of weather the Autotherm would be very effective to use. To have amortization of the 185.5 hours of operation, the unit would only have to be operated two to three times daily.


LONG WIRE TO THERMOSTAT
3
SHORT WIRE TO BATTERY DIRECT SOURCE
TERMINAL MARKED "BAT"
CIRCUIT BREAKER
LOOSE RED WIRE WITH FUSEHOLDER
TAP SPLICE CONNECTOR
RED
HEATER
BATTERY
CABLE TIE
BROWN
2
RED
THERMOSTAT
1
BLACK
RED
CIRCULATOR
BROWN OR BLACK

CAUTION: KEEP CIRCULATOR AND THERMOSTAT AWAY FROM EXHAUST MANIFOLD

— UNDER HOOD WIRING


TUBULAR SPLICE CONNECTORS
BUNDLE 1 (RED AND BROWN) TO ENGINE COMPARTMENT
FUNCTION SELECTOR SWITCH
FAN SPEED SWITCH
HEATER CONTROL SUPPLY WIRE
SEE TABLE 1
GROUND POINT
YELLOW
BLACK
FUSE PANEL
WHITE
HEATER CONTROL UNIT
ORANGE
GREEN
BLUE
RED
PILOT LIGHT
BUNDLE 2
RELAYS
4
5
ON-OFF SWITCH
BEZEL NUT
MAIN WIRE HARNESS

SECURE ALL WIRING OUT OF THE WAY WITH CABLE TIES SUPPLIED. ROLL EXCESS WIRE INTO LOOPS AND ATTACH TO EXISTING CABLES.

— UNDER DASH INSTALLATION

1. Circulator
2. Thermostat
3. Circuit Breaker
4. Relays
5. On-Off Switch/Pilot Light

FIGURE 1

Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
1942	29.0	25.5	36.4	49.2	55.6	62.6	68.0	66.7	59.0	49.8	43.0	34.8	48.3
1943	32.4	39.0	35.7	52.4	51.6	64.8	71.4	69.5	59.9	50.6	39.8	31.4	49.9
1944	30.8	32.6	35.4	41.2	55.7	63.8	67.9	68.0	60.0	52.7	38.8	31.4	48.2
1945	31.8	31.4	41.4	41.4	54.9	59.9	67.4	67.0	58.6	53.0	39.0		
#1946		31.4	42.6	52.6	49.8	63.0			61.5	47.3	36.4	36.8	
1947													
#1948				48.0	55.8	64.0	70.0	68.9	64.4	50.0	34.0	29.6	
1949	19.7	29.2	37.6	46.4	55.4	63.2	70.5	68.8	61.8	47.6	47.4	31.0	48.2
1950	31.3	36.9	36.3	45.5	52.4	64.9	66.0	66.1	58.8	57.5	38.3	34.6	49.1
1951	25.7	33.3	33.2	41.7	55.8	59.0	71.3	67.9	59.1	47.7	36.1	29.8	46.7
1952	34.0	32.4	32.1	45.3	54.6	70.5	70.1	70.1	62.4	51.4	31.5	30.9	48.8
1953	37.6	30.4	40.8	41.9	51.3	67.5	71.8	67.8	63.9	51.7	41.2	30.1	49.7
1954	35.4	41.1	34.1	52.0	54.2	67.9	74.0	70.3	64.6	50.7	42.3	33.9	51.7
1955	27.2	26.4	35.6	47.4	56.4	62.3	72.8	70.3	62.2	52.9	35.3	35.2	48.7
1956	31.4	26.7	37.8	44.1	58.7	70.3	70.0	67.6	64.3	52.7	34.8	33.4	49.3
1957	25.9	38.9	37.2	39.3	51.9	63.5	71.5	69.8	59.6	51.1	33.2	37.7	48.3
1958	32.7	36.6	31.3	43.2	60.2	66.2	68.8	70.7	62.6	52.0	40.2	35.0	50.0
1959	29.3	31.3	36.3	43.9	56.5	68.1	69.9	70.6	59.0	45.5	36.4	34.5	48.4
#1960	28.0	21.7	35.6	48.5	54.7	65.6	69.0	70.0	63.4	50.5	38.7	29.4	48.0
1961	30.1	32.9	36.2	43.6	54.7	63.4	68.2	68.4	54.3	48.6	34.9	24.7	46.6
1962	22.1	31.8	33.6	48.1	58.6	62.9	68.9	70.6	62.1	53.9	40.5	35.4	49.1
1963	21.9	38.7	38.4	51.0	60.2	69.0	75.5	69.8	65.4	58.2	42.1	27.2	51.5
1964	30.3	26.1	30.9	46.2	57.6	65.0	75.3	69.3	61.9	52.3	38.4	32.8	48.8
1965	35.4	27.8	25.6	48.3	54.9	62.1	69.4	65.8	55.0	52.9	43.8	34.7	48.0
1966	25.1	26.8	40.8	44.4	57.1	65.7	73.9	66.8	62.1	48.9	40.6	29.4	48.5
1967	33.1	33.0	42.9	48.2	52.4	62.0	69.3	66.1	60.6	52.3	39.6	25.3	48.8
1968	30.7	32.6	38.6	42.5	51.5	66.9	68.4	65.8	60.3	51.5	34.5	29.4	47.7
1969	33.4	33.8	29.6	48.9	56.8	59.7	71.7	70.2	61.9	41.5	37.0	30.8	48.0
1970	28.2	37.2	32.6	42.6	58.2	64.6	71.2	71.4	5747	44.2	38.2	32.9	48.3
1971	29.8	29.8	37.7	45.3	53.3	67.8	68.8	69.1	56.7	49.3	37.9	30.4	48.0
1972	30.0	36.1	43.3	49.1	55.9	67.8	68.9	67.7	60.8	49.4	29.8	23.5	48.5
1973	25.4	32.3	36.5	40.9	53.3	65.6	68.4	70.6	58.8	52.6	39.6	31.2	48.0
1974	27.0	33.9	42.1	46.0	59.7	66.2	72.6	67.9	58.0	52.6	38.5	28.0	49.4
1975	29.1	29.8	35.6	44.4	53.4	63.8	71.0	70.2	59.4	52.3	36.4	35.3	48.4
1976	30.1	37.8	36.1	47.7	54.7	64.3	72.1	68.1	59.3	45.7	36.2	32.9	48.8
1977	26.8	35.0	37.1	48.3	58.6	68.0	71.4	68.6	64.0	51.5	38.6	34.6	50.2
1978	25.1	27.7	40.9	48.8	52.5	66.2	72.8	67.5	62.8	51.9	36.5	21.9	47.9
1979	16.9	32.5	38.1	48.3	54.0	64.3	70.6	67.5	64.4	51.7	31.2	33.5	47.7
1980	26.7	34.3	35.7	44.3	53.4	69.2	75.3	70.4	62.3	49.9	39.5	39.8	50.1
1981	34.9	34.4	39.3	53.8	54.5	69.4	71.9	67.3	63.4	50.8	43.3	32.7	51.3
RECORD													
→ MEAN	28.8	32.4	36.3	46.0	55.4	65.5	70.9	68.7	61.0	50.7	37.9	31.6	48.8
MAX	41.9	45.5	49.2	59.4	68.5	79.6	84.7	82.2	74.7	64.5	51.0	44.7	62.2
MIN	15.6	19.2	23.4	32.6	42.2	51.4	57.1	55.2	47.2	36.9	24.8	18.4	35.3

6. Recommendations.

a. Recommend the Autotherm, P/N 2100 iT, be adopted for Air Force use based on test results of this project.

b. Recommend the Autotherm, P/N 2100 iT, be placed in TA 010 as this is an accessory to the basic vehicle.

c. Recommend that a note be put in TA 010 stating this item to be used on sedans, station wagons, pick-ups, 1 1/2 ton special purpose, and carryalls only.

d. Recommend that a message be sent to each Major Command addressing Security Police, CAM, Vehicle Operations, Protocol, Supply and Civil Engineering apprising them that item is available by NSN in TA 010.

VEHICLE MAINTENANCE

SAC

MANAGEMENT
EVALUATION
&
EQUIPMENT
PROGRAM

OFFUTT AIR FORCE BASE, NEBR.

STRATEGIC AIR COMMAND

PROJECT: HO 81-16C - AUTOTHERM HEATER (CAR COMFORT SYSTEM)

REPLY TO
ATTN OF:

9 July 1982

SUBJECT: Phase I Completion Report, MEEP Project No. HO 81-16C

TO:

IN TURN

1. Project Title: Autotherm Heater (Car Comfort System).

2. Date Started: 15 Jan 82.

3. Date Completed: 30 Apr 82.

4. Description:

a. The purpose of this project was to determine, through field evaluation if the Autotherm Heater (Car Comfort System) maintained the vehicle interior warmth in cold weather, reduced fuel consumption without undue battery load and provided adequate heat for comfort in an economical manner.

b. Equipment Evaluated: The Autotherm Heater (Car Comfort System), Model EVK-2100iT is designed to continue circulating heated coolant through the vehicle heater after the ignition switch is turned off. The manufacturer claims this unit will fit all 12-volt, water-cooled vehicles, is easily installed in one (1) hour, has fully automatic operation and is guaranteed against coolant leakage for the life of the original installation. The unit is also claimed to maintain the heated vehicle's interior for the following time frames per engine type/size with no wind:

4 cylinder @ 32°F. - 30 to 45 minutes

4 cylinder @ -15°F. - 10 minutes

V-8 @ 32°F. - 1¼ hours

V-8 @ -15°F. - 30 minutes

400 CID @ 32°F. - 1 hour

400 CID @ -15°F. - 1 hour

Cost of the system kit was $132.40.

5. Work Accomplished:

a. To accomplish this evaluation, two (2) Autotherm Heaters were evaluated at Loring AFB, ME and two (2) at Offutt AFB, NE.

Offutt AFB, NE

79B5112 (Test) - Security Police/Law Enforcement

79B5214 (Control) - Security Police/Law Enforcement

79B5599 (Test) - Vehicle Operations/Base Protocol

79B5601 (Control) - Vehicle Operations/Base Protocol

Loring AFB, ME

74B631 (Test) - Security Police/Alert Response Team (ART)

74B638 (Control) - Security Police/Alert Response Team (ART)

81B2380 (Test) - Security Police/Alert Response Team (ART)

81B2379 (Control) - Security Police/Alert Response Team (ART)

b. Base project monitors were appointed and local procedures were established for collecting maintenance and operational data.

6. Discussion:

a. Offutt's test units were received on 15 Jan 82. The four (4) selected project vehicles were called in to Vehicle Maintenance for preparation.

(1) Vehicle engines were tuned to manufacturer's specifications. All needed parts were installed at this time. Chassis dynamometer tests were performed to ensure peak engine performance was achieved.

(2) Installation of the test units was accomplished by two (2) civilian mechanics (WG-10s) assigned to the General Purpose Shop. Installation times were as follows:

79B5112	Plymouth	225CI, 6 cyl	6.5 Labor Hours
79B5599	Ford	2.3L, 4 cyl	7.0 Labor Hours

(3) Manufacturer's installation instructions appear to be adequate and easily read by the mechanics.

(4) In some cases, as with the 4 cyl, 2.3L Ford engine, steel tubing and short pre-moulded hoses are used in the heater circuit. Standard heater hose had to be used for installation of the circulator and thermostat units to ensure proper distance from the exhaust manifold.

(5) Both security police vehicles at Offutt required engine tune-ups during this evaluation. Neither required parts.

b. Loring's test units were received on 18 Jan 82. The four (4) selected project vehicles were called into Vehicle Maintenance for preparation.

(1) Vehicle engines were tuned to manufacturer's specifications. All required parts were installed at this time. Chassis dynamometer tests were performed to ensure peak engine performance was achieved.

(2) Installation of the test units was accomplished by one mechanic assigned to the General Purpose Shop. Installation times were as follows:

74B631	Chevrolet	350, V-8	2.5 Labor Hours
81B2380	AMC	258, 6 cyl	7.0 Labor Hours

c. Average installation labor time was 5.75 hours x $16.00 = $92.00 cost. Installation labor time will decrease as mechanics become familiar with the different types and models of vehicles. See Atch 2.

d. During this evaluation, the test vehicles accumulated 15,995 miles (Loring and Offutt) and 296.4 hours (Offutt's hours only) on the Autotherm Heaters at a $0.261 O&M cost per mile. The control vehicles accumulated 16,079 miles at a $0.223 O&M cost per mile. See Atch 3. Due to the operating environment and the age/condition of the vehicles' engines, the test and control vehicles' O&M cost per mile is misleading.

e. Loring AFB's test unit hourmeters were not operating properly or they were incorrectly wired up. One of the test units accumulated 1.3 hours and the other zero. No explanation or estimate of accumulated hours could be made by the project monitor.

f. A fuel flow test at idle was made on test vehicle 79B5112, 225CI, 6 cyl engine to determine the amount of fuel saved by operating the Autotherm Heater. Results may vary depending on the vehicle engine size. Results are as follows:

- 2.3 hours per gallon was obtained by this vehicle.
- 296.4 hours ÷ 2.3 = 128.7 gallons of fuel saved.
- 128.7 gallons x $1.29 per gallon = $166.02 saved.

g. A current draw test of Offutt's test units was made and the results are as follows:

79B5112	Heater Fan on Low -	2 AMPS
	High -	5 AMPS
79B5599	Heater Fan on Low -	4 AMPS
	High -	11 AMPS

h. Durability: During the evaluation period, we experienced no problems with the inbailed units.

7. Safety: To the best of our knowledge, the inbailed units meet or exceed the Health Act and EPA Standards. Safety precautions that are normally observed when working on automotive electrical systems must be observed when servicing or installing the units.

8. Advantages: There were two (2) advantages noted with the inbailed Autotherm Heaters during this evaluation.

a. The Autotherm Heaters were able to maintain the vehicles' interior warmth for a reasonable period of time after the engine was shut off. See Atch 4. Loring AFB failed to conduct temperature tests as directed.

b. The Autotherm Heater has presented the Air Force with a savings of 128.7 gallons of gasoline at a savings of $166.02.

9. Disadvantages: None noted.

10. Tangible Savings: A tangible savings of $605.70 per unit in a five (5) year life cycle has been noted. A command savings of $393,705 has been noted. See Atch 5.

11. Intangible Savings: The Autotherm Heater has presented the Air Force with a unit/system that will maintain the vehicle

interior warmth for a reasonable period of time after the engine is shut off, which would prevent the chance of exhaust emissions entering the vehicle. By being able to keep the vehicle interior warm, it will improve morale of the people who have to sit in these vehicles that are in areas where the engine cannot be operated.

12. Recommendations: Based on the data gathered during this evaluation, the Autotherm Heater is recommended for Air Force use.

a. The Autotherm Heater has shown a tangible savings of $605.70 during its life cycle. See Atch 5.

b. Recommend the Autotherm Heater be considered for use in the following areas and types of vehicles.

(1) Security Police: Law enforcement sedans, pickup trucks and jeeps.

(2) Base Taxi: Sedans, station wagons and pickup trucks.

(3) Flightline Aircraft Maintenance Support: Pickup trucks.

c. Recommend the Autotherm Heater be listed in TA 010 as a vehicle attachment with a BOI of "As Required."

d. Within this command, there is an anticipated need for [redacted] units.

USAF 5 Atchs
1. Project Directive
2. Photos
3. O&M Cost Summaries
4. Controlled Temperature Tests
5. Cost/Savings Computation

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS WARNER ROBINS AIR LOGISTICS CENTER (AFLC)
ROBINS AIR FORCE BASE, GEORGIA 31098

8 DEC 1981

RAB

REPLY TO ATTN OF: R-ALC/MMIRAB-1 (Mr. Cronin, 2676) DEC 2 1981

SUBJECT: Management and Equipment Evaluation Program (AFR 77-5) Project Directive H81-16C

TO: [redacted] [redacted]

1. Project Title: Autotherm Heater (Car Comfort System)

2. Equipment to be evaluated:

   a. Model EVK-2100iT Energy Conservation System

      (1) Circulator Pump

      (2) Thermostat Switch

      (3) 12V SPST Relays - 2 each

      (4) Hour Meter

      (5) Control Switch/Indicator Light

      (6) Installation Wire, Connectors, Fuseholder and Hardware

eater system is designed to continue circulating heated water through the ehicle heater after the ignition switch is turned off. Manufacturer claims thi odel will fit all 12-volt, water-cooled vehicles, easily installed in one hour, ully automatic operation, and guaranteed against coolant leakage for life of riginal installation. Also claimed is ability of device to maintain heated ehicle interior for the following time frames per engine type with no wind:

4 Cylinder @ 32°F - 30 to 45 minutes

4 Cylinder @ -15°F - 10 minutes

V-8 @ 32°F - 1 1/4 hours

V-8 @ -15°F - 30 minutes

400 CID @ 32°F - 1 hour

400 CID @ -15°F - 1 hour

Cost of system kit is approximately $132.

Atch 1

b. Tune vehicles to manufacturer's specifications and install conservation system on each selected vehicle. Comment on ease of installation, difficulties encountered, time to install, and any additional training required.

c. Establish adequate procedures for base mechanic installation.

(1) Include appropriate level mechanic required to perform installation and any additional training needed.

(2) Comment on adequacy of manufacturer's installation instructions.

(3) Specify any additional equipment/items necessary which exceed normal kit requirements.

d. Develop forms/instructions needed for operating/servicing personnel to acquire MPG/O&M costs to operate Autotherm equipped vehicles in comparison to vehicles not so equipped.

e. Assure that kit installation is proper by following Autotherm Manufacturer's checks and insuring vehicle is still tuned to vehicle manufacturer's specifications after installation is completed.

f. Operate vehicles under normal mission assignment. Collect data to obtain average MPG, battery current drain, and fuel/service costs for Autotherm equipped and non-equipped vehicles over project test period. Identify all project vehicles by registration number.

(1) Comment on any problems experienced and resolution of same.

(2) Record any adjustments necessary for satisfactory vehicle performance.

(3) Install ammeter in series with negative lead of battery and record current drain. Record all data in accordance with appropriate MOIs/forms/instructions for each test vehicle.

(4) Compare ease of servicing vehicle employing Autotherm Heaters versus those without test units.

(5) Determine average costs required to install energy conservation systems on various Air Force vehicles.

(6) Compare effects of temperature extremes on heater effectiveness and time period of comfortable ambient of vehicle interior. Site any locations where heaters would be cost prohibitive/ineffective.

(7) Compare MPG/O&M costs to operate vehicles with and without Autotherm units. (Be sure to include all costs for charging/replacing batteries, if applicable.)

OPIED ON GOVERNMENT COPIER 71

(8) Comment on operator acceptance of heater system use and note any significant unacceptable concerns.

(9) Cite any safety considerations related to overall employment of Autotherm System.

g. Include all data/comments called for and any other findings considered significant to the evaluation.

h. Expand on manufacturer's manual to provide complete installation, operation, and servicing instructions including adequate parts breakdown information.

i. Specify appropriate vehicle candidates for conversion if recommended for adoption and any constraints which would limit Autotherm device application. (Such as mission purpose, climatic influence, or battery loading.)

j. Include an economic analysis supporting your recommendations. Complete Attachment I (modified as appropriate) to reflect dollar savings/cost avoidance figures.

k. Summarize results of all test data. Cite conclusions reached.

l. Project first year anticipated base/command buy requirements for any quantities recommended for adoption.

m. Make firm recommendations for final action as supported by test data/findings on the following:

(1) Adopt or non-adopt Autotherm Car Comfort System.

(2) Specify TA and BOI changes consistent with your recommendations.

(3) Appropriate method of procurement (CP/LP/other) for any new item recommended for adoption.

(4) Appropriate means to service/maintain adopted items (i.e., service contract, base vehicle shops, etc.).

7. Authority for project: AFR 77-5.

8. Priority assigned: III

9. Duration of project: Completion date is 15 Jun 1982. Completion report to arrive WR-ALC/[redacted] no later than 5 July 1982.

14

COPIED ON GOVERNMENT COPIER 71

10. Technical Publications: Manufacturer's manuals/guidelines will be furnished with Car Comfort System.

11. Technical Assistance: Will be provided by WR-ALC/[redacted] upon request.

12. Special Funding Instructions: None. Test items will be furnished through no-cost imbailment initiated by WR-ALC/[redacted].

13. Disposition of Equipment: Request for disposition kits will be forwarded to WR-ALC/[redacted] with information copy to WR-ALC/[redacted]. Upon shipment of returned items, a copy of shipping document will be forwarded to WR-ALC/[redacted].

14. Project Classification: Unclassified. Project may be discussed verbally with manufacturer's representative. However, no remarks will be made to obligate the USAF. No information will be released to one manufacturer on another's product. Advise commercial suppliers of bailment items, who desire written evaluation report, to address their request to WR-ALC/[redacted].

15. Project Monitor: James F. Cronin, alternate: Durwood Graham, WR-ALC/[redacted] AV 468-2676.

16. Reporting: To be accomplished in accordance with MEEP Reporting Instructions.

1 Atch
Savings Computation Format

hief, Aircraft Items & Vehicle Section
ngineering & Reliability Branch
Item Management Division, D/MM

Cy to:
HQ USAF/LETN
HQ AFLC/LOWCS
HQ ATC/LGTV
SA-ALC/MMIRGA

Peterson AFB CO 80914

✓

Offutt AFB NE 68113

Chanute AFB IL 61868

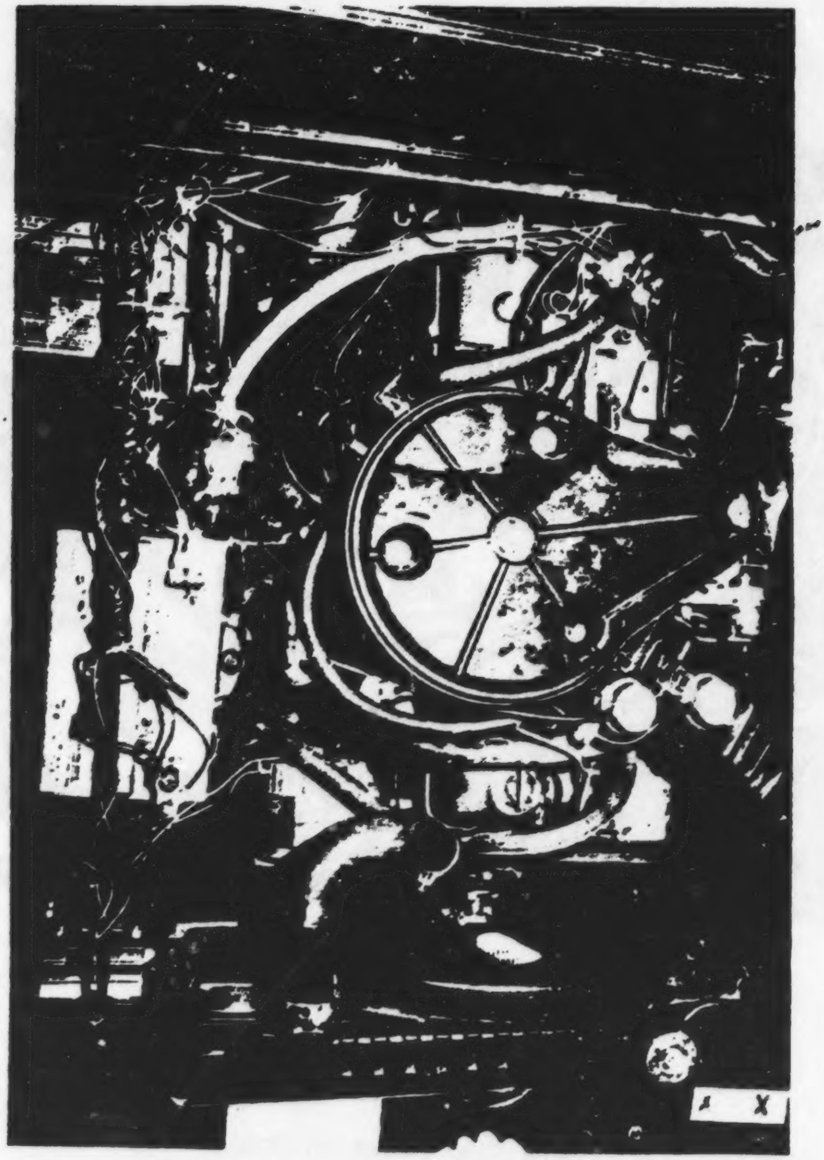
Columbus AFB MS 39701

Lowry AFB CO 80230

Loring AFB ME 04750

COPIED ON GOVERNMENT COPIER 71

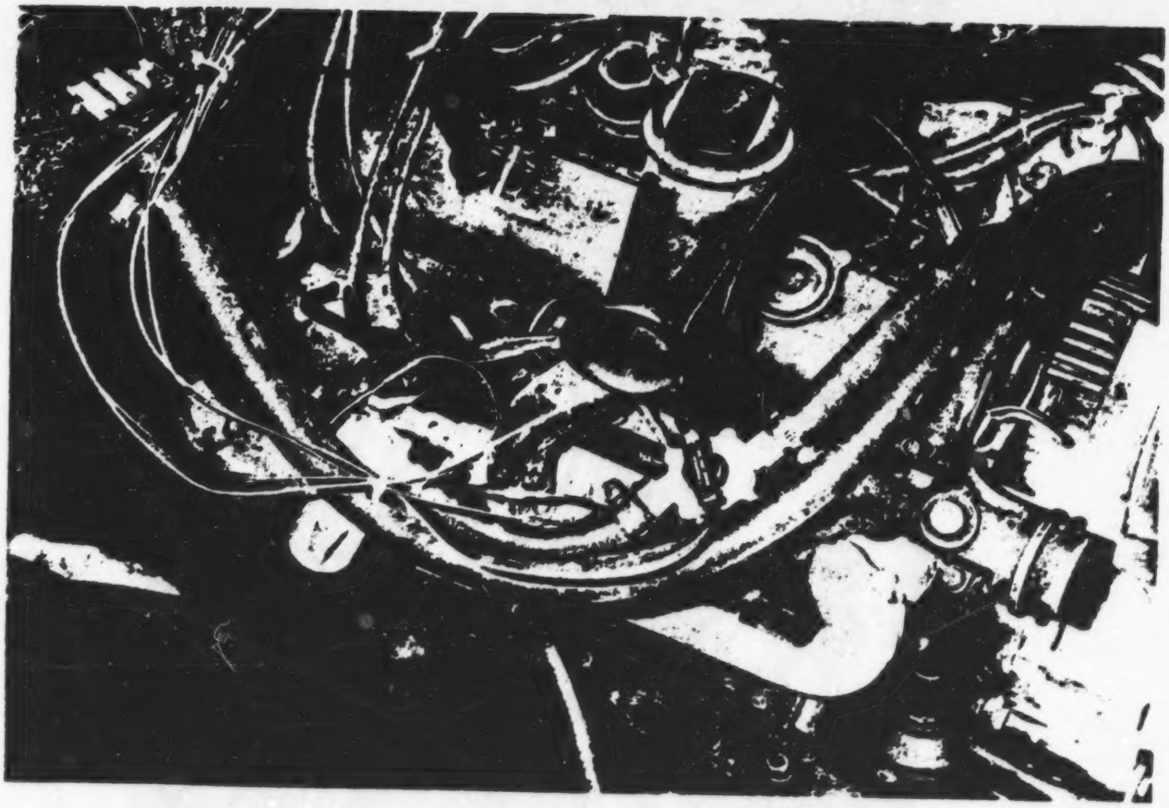
Autotherm Heater Installation



1981 AMC Jeep CJ-7

Atch 2

Autotherm Heater Installation



1974 Chevrolet Pickup C-10

2^2

Offutt AFB, NE

Test Vehicle 79B5112

Operation Cost:

Miles Traveled: 9,861

Fuel Consumed:	826.9	x	$1.29	=	$1,066.70
Oil Consumed:	20.0	x	.49	=	9.80
MPG: 11.93					$1,076.50

Operation Cost per Mile: $1,076.50 ÷ 9,861 = $0.109

Direct Maintenance Cost:

Material Cost:	$108.02
Labor Cost:	353.71
	$461.73

Direct Maintenance Cost per Mile: $461.73 ÷ 9,861 = $0.047

Total O&M Cost per Mile: $0.156

125.1 hours accumulated on the Autotherm Heater.

Control Vehicle 79B5214

Operation Cost:

Miles Traveled: 11,705

Fuel Consumed:	808.8	x	$1.29	=	$1,043.35
Oil Consumed:	18.0	x	.49	=	8.82
MPG: 14.47					$1,052.17

Operation Cost per Mile: $1,052.17 ÷ 11,705 = $0.090

Direct Maintenance Cost:

Material Cost:	$167.46
Labor Cost:	254.73
	$422.19

Direct Maintenance Cost per Mile: $422.19 ÷ 11,705 = $0.036

Total O&M Cost per Mile: $0.126

Test Vehicle 79B5599

Operation Cost:

Miles Traveled: 1,389

Fuel Consumed: 72.9 x $1.29 = $94.04
Oil Consumed: 0.0 x .49 = .00

MPG: 19.05

$94.04

Operation Cost per Mile: $94.04 ÷ 1,389 = $0.067

Direct Maintenance Cost:

Material Cost: $ 0.00
Labor Cost: 84.60

$84.60

Direct Maintenance Cost per Mile: $84.60 ÷ 1,389 = $0.060

Total O&M Cost per Mile: $0.127

171.3 hours accumulated on the Autotherm Heater.

Control Vehicle 79B5601

Operation Cost:

Miles Traveled: 1,065

Fuel Consumed: 66.0 x $1.29 = $85.14
Oil Consumed: 2.0 x .49 = .98

MPG: 16.14

$86.12

Operation Cost per Mile: $86.12 ÷ 1,065 = $0.080

Direct Maintenance Cost:

Material Cost: $ 0.00
Labor Cost: 0.00

$ 0.00

Direct Maintenance Cost per Mile: $0.00 ÷ 1,065 = $0.000

Total O&M Cost per Mile: $0.080

Loring AFB, ME

Test Vehicle 74B631

Operation Cost:

Miles Traveled: 2,520

Fuel Consumed: 944.0 x $1.29 = $1,217.76
Oil Consumed: 9.0 x .49 = 4.41

MPG: 2.67 $1,222.17

Operation Cost per Mile: $1,222.17 ÷ 2,520 = $0.485

Direct Maintenance Cost:

Material Cost: $ 0.00
Labor Cost: 111.48

$111.48

Direct Maintenance Cost per Mile: $111.48 ÷ 2,520 = $0.042

Total O&M Cost per Mile: $0.529

Control Vehicle 74B638

Operation Cost:

Miles Traveled: 1,867

Fuel Consumed: 769.2 x $1.29 = $ 992.27
Oil Consumed: 8.0 x .49 = 3.92

MPG: 2.43 $ 996.19

Operation Cost per Mile: $996.19 ÷ 1,867 = $0.534

Direct Maintenance Cost:

Material Cost: $ 30.51
Labor Cost: 136.98

$167.49

Direct Maintenance Cost per Mile: $167.49 ÷ 1,867 = $0.089

Total O&M Cost per Mile: $0.623

Test Vehicle 81B2380

Operation Cost:

Miles Traveled: 2,225

Fuel Consumed:	673.4	x	$1.29	=	$868.69
Oil Consumed:	2.0	x	.49	=	.98
MPG: 3.30					$869.67

Operation Cost per Mile: $869.67 ÷ 2,225 = $0.391

Direct Maintenance Cost:

Material Cost:	$ 8.79
Labor Cost:	250.51
	$259.30

Direct Maintenance Cost per Mile: $259.30 ÷ 2,225 = $0.117

Total O&M Cost per Mile: $0.507

Control Vehicle 81B2379

Operation Cost:

Miles Traveled: 1,442

Fuel Consumed:	399.0	x	$1.29	=	$514.71
Oil Consumed:	4.0	x	.49	=	1.96
MPG: 3.61					$516.67

Operation Cost per Mile: $516.67 ÷ 1,442 = $0.358

Direct Maintenance Cost:

Material Cost:	$ 30.99
Labor Cost:	309.72
	$340.71

Direct Maintenance Cost per Mile: $340.71 ÷ 1,442 = $0.236

Total O&M Cost per Mile: $0.595

Controlled Temperature Tests

	Test Vehicle	Control Vehicle
Vehicle Reg. No.:	79B5599 2.14	79B5601
Date: 4 Feb 82		
Time: 1310		
Temperature: 12°F.		
Weather Condition: Snowing/no wind		
Occupants: One (1)		
First Temperature Reading:	85°	88°
+ 15 minutes	85°	78°
+ 30 minutes	77°	70°
+ 35 minutes	75°	67°

Comments: Temperature tests were ended when the Autotherm Heater shut the fan off.

Controlled Temperature Tests

	Test Vehicle	
Vehicle Reg. No.:	79B5112	
	With Autotherm	Without Autotherm
Date: 21 Jan 82		
Time:	0800	0905
Temperature: 12°F.		
Weather Condition: Snowing/no wind		
Occupants: One (1)		
First Temperature Reading:	83°	83°
+ 15 minutes	80°	65°
+ 30 minutes	73°	58°
+ 40 minutes	68°	54°

Controlled Temperature Tests

	Test Vehicle	Control Vehicle
Vehicle Reg. No.:	79B5599 234	79B5601
Date: 4 Feb 82		
Time: 1310		
Temperature: 12°F.		
Weather Condition: Snowing/no wind		
Occupants: One (1)		
First Temperature Reading:	85°	88°
+ 15 minutes	85°	78°
+ 30 minutes	77°	70°
+ 35 minutes	75°	67°

Comments: Temperature tests were ended when the Autotherm Heater shut the fan off.

Cost/Savings Computation

1. Test Unit:	Autotherm Heater
2. Unit Cost:	$132.40
3. Quantity Required per Base:	25
4. Life Expectancy (Years):	5
5. Accumulated Hours During Evaluation: (Based on One (1) Test Unit)	148.2
6. Accumulated Hours in One Year:	296.4
7. 296.4 ÷ 2.3 hours = Gallons of Fuel	128.7
8. 128.7 Gallons x $1.29 per Gallon = Saved	$166.02
9. Installation Cost: ($16.00 x 5.75)	$ 92.00

10. Life Cycle Cost Savings:

$$\frac{\$830.10}{(8 \times 4)} - \frac{\$224.40}{(2 + 9)} = \frac{\$605.70}{\text{Savings per Unit}}$$

11. Command Savings:

$$\frac{25}{\text{Units per Base}} \times \frac{26}{\text{Bases}} = \frac{650}{\text{Vehicles}} \times \frac{\$605.70}{\text{Life Cycle Savings}} = \$393{,}705.00$$

ATTACHMENT K

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

OFFICE OF
AIR, NOISE AND RADIATION

July 26, 1984

Mr. Robert Jaeger
AUTOTHERM Sales Corporation
314 East Main Street
Barrington, Illinois 60010

Dear Mr. Jaeger:

This letter is to inform you that we received your May 21, 1984 application for evaluation of the "AUTOTHERM Energy Conservation System" under Section 511 of the Energy Policy and Conservation Act. We have performed a preliminary review and have the following concerns:

1. Section 2d of your application does not include your address, so EPA will assume that 314 East Main Street, Barrington, Illinois 60010, which appears at the bottom of each page of your application, is the correct address.

2. Under Section 3b(1), your application states that the AUTOTHERM Energy Conservation System is applicable to any vehicle with a water cooled engine, except "Mercedes Benz vehicles, due to their use of vacuum heater controls." Other vehicles also use vacuum heater controls; your description does not provide enough detail to explain the unique features of Mercedes Benz vacuum heater controls that prevent the application of the AUTOTHERM system. Please provide additional information to permit us to further understand which types of heaters allow or prohibit AUTOTHERM system utilization.

3. Section 3c of your application is rather brief and does not reference any of the additional material you provided. EPA will assume that the descriptions of the theory and principles of operation in, a) brochure AMFSB-36-1/82-25M, and b) "Fleet Fuel Survey" - Form Number AM-SB-EV-F-001 11/81-5M, are explanations that you wish to reference to meet the requirements of Section 3c of the Application Format.

4. Section 3e makes claims for fuel and maintenance cost savings but does not segregate them. Please provide additional information, or reference information already sent, on the cost savings due to, a) reduced fuel consumption, and b) the maintenance cost reductions you attribute to the AUTOTHERM system. We also need information on how the cost savings were calculated and the assumptions used.

A critical assumption will be the percentage of time that drivers will forego idling and use the AUTOTHERM system. You have not given EPA any information on driver willingness to use the AUTOTHERM system in lieu of idling. The probability of 100 percent of the drivers, with AUTOTHERM system equipped vehicles, using the AUTOTHERM system is very low. Some drivers may not be willing to change their ways. The probability of optimum AUTOTHERM system use, by drivers who do use the system is open to question. The question is then, what are the actual utilization rates? Do you have any data that document driver utilization rates of the AUTOTHERM system in suitably equipped fleet vehicles?

5. The price sheet referenced in Section 3f has an effective date of September 1, 1983. Is this price sheet current?

6. Section 4b references a stick-on label (Form Number AM-D-6-2M-4/83), but this label does not include information on maintenance and diagnostics. Since the "Installation and Owners' Manual" provides both operating instructions and diagnostics, EPA will assume that you wish to reference this manual. No maintenance information was provided, but the reason becomes apparent in Section 4d which states that no maintenance is required.

7. The literature enclosed with your letter of September 22, 1983 included a "Fleet Fuel Survey" brochure (Form Number TC101-9/83) that included a footnote that states the following: "Acknowledged by National Bureau of Standards and U.S. Environmental Protection Agency as an effective fuel saving device." Please explain the basis for your claim as I am not aware of any previous EPA involvement with the AUTOTHERM Conservation System. Additionally, I must caution you that the U.S. Government does not "approve" fuel economy devices, but does permit test data resulting from an evalution to be cited.

Please inform us if any of the assumptions EPA has made in paragraphs numbered 1, 3, and 6 are incorrect. It will be helpful if you would provide the information requested in paragraphs numbered 2, 4, 5, and 7 by August 20, 1984.

Sincerely,

Merrill W Korth

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

file "Autotherm"

Rec'd. 8-15-84

ATTACHMENT L

AUTOTHERM
Sales Corp.

August 10, 1984

Mr. Merrill W. Korth
Device Evaluation Coordinator
UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY
Motor Vehicle Emission Laboratory
2565 Plymouth Road
Ann Arbor, Michigan 48105

Dear Mr. Korth:

I am sorry for the oversights in my May 21st application. I will cover them as listed in your July 26th letter:

1. Since the address was included in 2.c.3, I neglected to repeat it in 2.d. It is the same.

2. Section 3.b.1. The AUTOTHERM system does not work with vehicles whose vacuum controlled air mix door switches to the air conditioning mode on engine shutdown. The 1974 Chrysler was the last American car made with that system. We have not checked Mercedes beyond the 1979 model year since practically none of the fleets using the AUTOTHERM system have Mercedes vehicles.

3. I appreciate your suggestion to reference brochure AMFSB-36-1/82-25M and Fleet Fuel Survey form AM-SV-EV-F-001 11/81-5M as additional information for section 3.c. If you believe it applicable, report 004641, Office of Energy Related Inventions, National Bureau of Standards, might also afford additional information to Section 3.c.

4. The fuel survey forms referenced in Section 3.c. have listed average fuel consumption at idle for various size engines. Fuel savings would be 100% of fuel that would be used for a given engine size multiplied by the cost of fuel in a given area at a given time. I cannot cite references at this time, but articles have appeared in automotive journals on numerous occasions indicating that excessive idling will cause formation of gum, sludge and corrosion in an engine leading to poor performance and additional service costs. It has also been pointed out that excessive idling can lead to overheating and burnout of the catalytic converter -- a costly replacement item plus a possible fire hazard. In addition to savings, each hour of idling elininated also eliminates an hour of exhaust gas pollution. A copy of a newspaper article is enclosed referring to a severe problem caused by excessive idling.

314 EAST MAIN ST. • BARRINGTON, ILLINOIS 60010 USA • 312-381-6366

Mr. Merrill W. Korth
United States
Environmental Protection Agency
Ann Arbor, Michigan

August 10, 1984

Page - 2

We have no quantitative data on percentage use of the AUTOTHERM system and we have had fleet administrators -- primarily law enforcement -- decline to purchase AUTOTHERM kits based on the fact that they did not believe all of their drivers would use them. Those who purchased the AUTOTHERM system usually ran a test and determined that they could control usage and a savings would result before ordering larger quantities. A number of fleet operators have told us the AUTOTHERM system was so well received, they would probably have the system installed for the comfort and morale of their drivers even without a savings. We would not expect 100% usage, but habits can be broken since it is certainly more comfortable to sit in a parked vehicle without the noise, vibration and possible exhaust blowback of an idling engine. Another point regarding those who leave the engine idling while they are not in the vehicle is that they are breaking the law in all but four states by leaving the vehicle unattended with the engine running.

5. The price sheet referenced in Section 3.f. effective September 1, 1983 is current.

6. The AUTOTHERM "Installation and Owners Manual" is included with each kit and will give the owner additional information over and above the simple operating instructions on the label referenced in Section 4.b.

7. My predecessor had been using the statement, "acknowledged to be an effective fuel saving device by the U.S. Environmental Protection Agency" and it is my understanding this was based on a letter written by you to the EPA in Alaska recommending the AUTOTHERM System. We are aware the U. S. Government does not approve devices or products and thought the statement used was acceptable. Please let me know if that is not the case.

Sincerely,

AUTOTHERM SALES CORP.

Robert O. Jaeger

ROJ:hlt

enc.

(The copy of the newspaper article referred to by applicant in his letter of August 10, 1984 is not completely legible. That portion of the article which the applicant underlined appears below:

Chicago Tribune Friday, May 13, 1983

> "...after the engine in her previous car burned out because of the many hours it spent idling in front of City Hall."

Copy of newspaper article will be furnished upon request.